THE PRACTICAL WOODWORKER

Edited by Bernard E. Jones

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A COMPLETE GUIDE TO THE ART AND PRACTICE OF WOODWORKING

Written and Illustrated by Experts

and Edited by

BERNARD E. JONES

Editor of "Work," "The Amateur Mechanic," etc.

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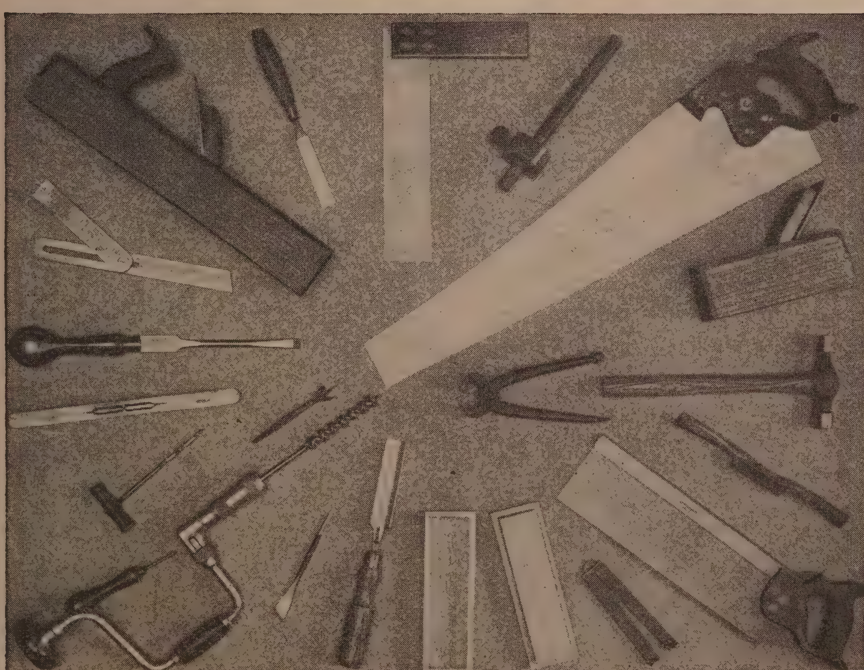
THE PRACTICAL WOODWORKER

The Scope and Object of this Work

"The Practical Woodworker" is believed to be the most comprehensive and exhaustive book yet published on practical woodworking. And yet it does not attempt to give every detail of every aspect of woodwork, because only a library of books could do that. But it does attempt so to instruct the reader as to make it possible for any person, even for one who has never even seen a plane or driven a nail, to be able from this book alone to make any ordinary piece of woodwork by sound craftsman-like methods. The book assumes scarcely



A Group of the Woodworker's Essential Tools

anything on the reader's part, and it omits nothing essential. It leads the beginner forward, step by step, from simple and elementary tool processes to the construction of difficult and advanced pieces of work. Not only that, for every craftsman, no matter how expert, can learn something from its pages. There is no denying that no one man can know everything about his trade; he cannot help being ignorant of some devices and "short cuts." Consequently, as this book is the result of the collaboration of many acknowledged experts—each an authority on his own branch of woodwork—everybody without exception can learn something from its pages.

This book is not academic; instead it is practical. But where a little theory is necessary for understanding and the acquisition of skill it is given. A deliberate attempt has been made to present in crisp, simple language and by the clearest of photographs and working drawings the essentials of skilled woodworking.

Little can be done in woodworking without a bench. If desired, a bench can be converted from an old table. Among the benches described throughout the book are some with racks, vices, bench stops, drawers, etc. Many craftsmen build a timber workshop to work in. Various types of workshops are shown in working drawings, and full instructions on their erection are given; and to make the workshop complete, grindstones, nail boxes, glue pots, steam-bending apparatus, saw stools and other workshop appliances and fittings are described in a later chapter. Instruments for marking and setting out are fully described and illustrated.

The reader will at once note that this book develops the subject progressively. The woodworker must understand and know how to select and purchase his tools; much money can easily be wasted in buying unsuitable or faulty ones. The uses and necessity of tools and the faults to be looked for and latest improvements to be obtained in them are therefore

explained and illustrated. Freak tools and amateur combination tools are not usually welcomed by the craftsman; but where a new tool or an improvement of an old one is on the market it is discussed, and, if thought an advantage, it is recommended. Many new tools may appear at first sight to be excellent contrivances, but after prolonged trial they are found not to be so useful as they look; on the other hand, it must be confessed that workmen are often slow in adopting new tools that undoubtedly make for quicker, easier or better work. Many really good tools in use in America are seldom, if ever, seen in Great Britain, and a number of these will be referred to, as in many cases they could be adopted with advantage.

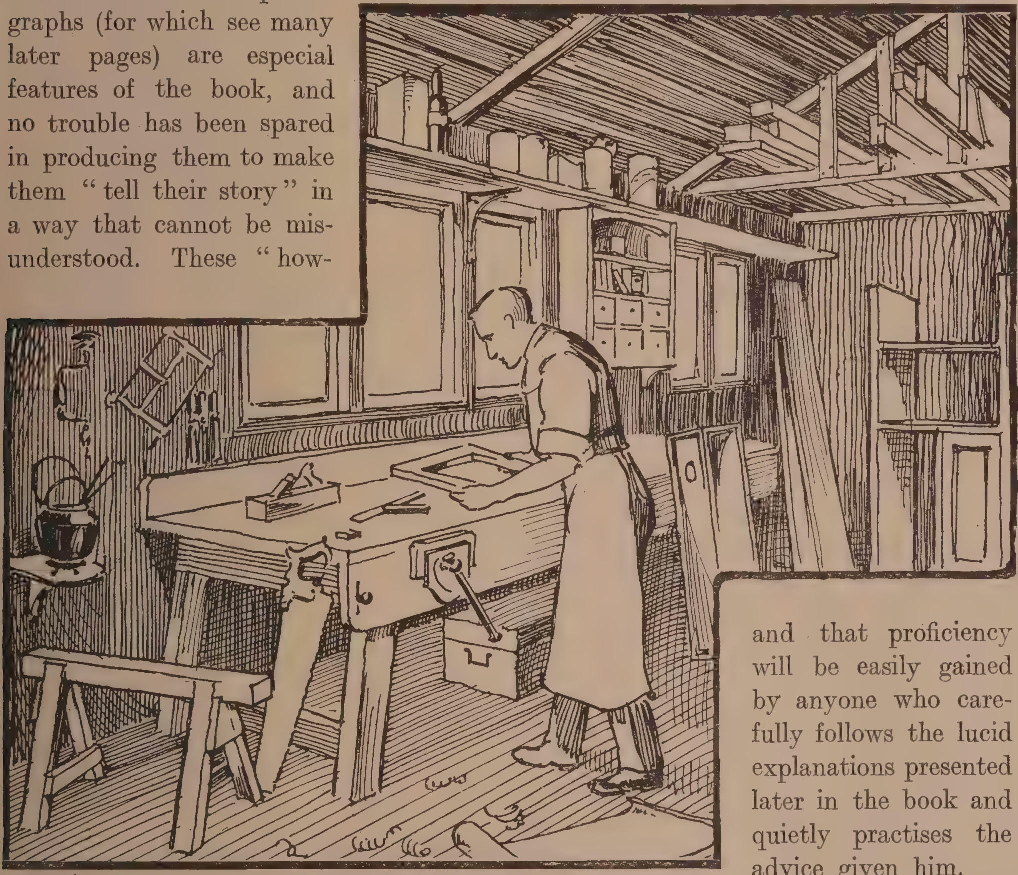
Tools are treated very fully in this book, but the reader will remember that most jobs require only a quarter of the number described, and the amateur or apprentice need get only a few of them to begin with; his kit can be added to as his skill increases or as more difficult or specialised jobs come his way.

A formidable obstacle to the amateur or apprentice is the getting of his tools into good order and the keeping of them in perfect working condition. Edge tools, as chisels and planes, are not in good order when purchased new, and have to be sharpened and adjusted. Even skilled workmen often fight shy of sharpening their own saws. The upkeep, adjustment, sharpening, and grinding of every kind of woodworking tool is gone into thoroughly in this book with the determination to make every operation easy of attainment even by the novice. There is much truth in the saying "a workman is known by his tools," and sharp, correctly adjusted tools are not only necessary for the performance of good work, but they make work a pleasure instead of a harassing drudgery.

After understanding the shapes and uses of tools and

A Group of Examples which will be shown in detail in later pages

after buying a few, the next thing is to learn how to hold and use them—a subject that provides a *motif* for the illustrations on pages 2 and 3. Tool operations and processes of woodworking are demonstrated clearly by many scores of photographs showing expert craftsmen at work. These photographs (for which see many later pages) are especial features of the book, and no trouble has been spared in producing them to make them "tell their story" in a way that cannot be misunderstood. These "how-to-do-it" pictures are, it is believed, unique in their thoroughness, clearness and detail, and they have been especially taken and posed for by the Editor and his Assistants.

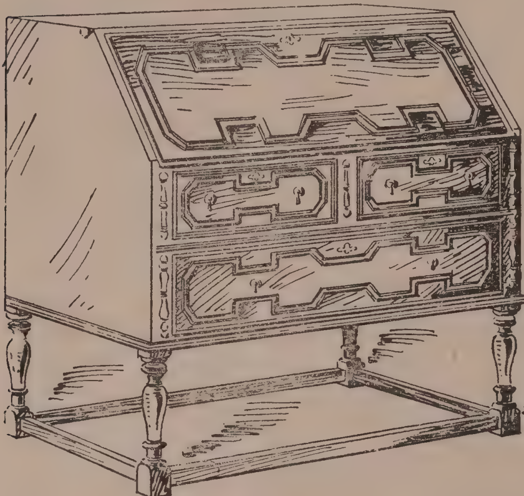


A Typical Woodworking Shop

The next step in woodworking is obviously the making of joints. Scores of these, from all branches of woodwork, are illustrated in complete detail and practical information given on making them. Dovetailing, in particular, is dealt with simply and exhaustively. Proficiency in this branch of woodworking is the hall-mark of the skilled craftsman, and that proficiency will be easily gained by anyone who carefully follows the lucid explanations presented later in the book and quietly practises the advice given him.

Before any piece of work is begun it has usually to be designed (by drawing out on paper), and later, for workshop use, the drawing has to be set out, full size, or, at any rate, to a large scale, on boards. These two processes are dealt with in a chapter on drawing for woodworkers. Setting-out is

an indispensable process in modern woodworking; it gives speed and helps to accuracy and the avoidance of mistakes.



Jacobean Bureau

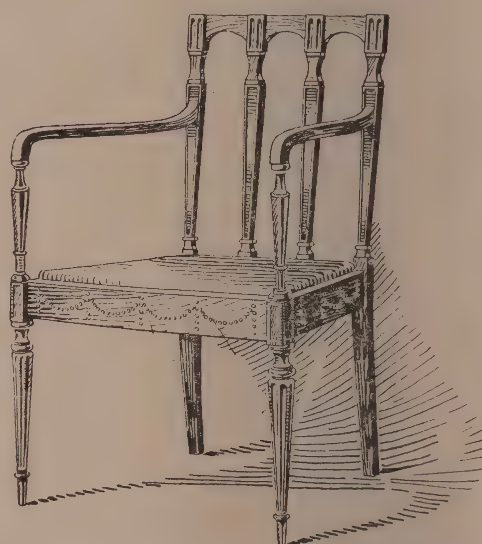
And it is a subject that can be simply explained, being merely a workshop adaptation of ordinary projection.

We now come to the construction of the actual woodwork examples, many of which are illustrated on a very small scale on pages 4 and 7. Some of these, as seats, steps, simple doors, tables, etc., are easily made, and do not require very accurate work or the use of many tools. Others, as bookcases, writing desks, sideboards, etc., require more care and skill, but one and all can be made, from sawing the timber to applying the polish, by anyone who will follow the instructions given in this book. And these examples will not be made anyhow, but with the best finish and by the best methods known to the skilled workman if the reader will but do as he is taught.

The book touches on every aspect of woodworking, but some sections have advisably not been treated as fully as others; furniture making, being perhaps the most useful section to the average woodworker, has been made the subject of hundreds of examples, whereas sections like foundry pattern making and aeroplane woodwork are briefer, although adequate, in their treatment. A glance at the table of contents will show the wide scope of the book.

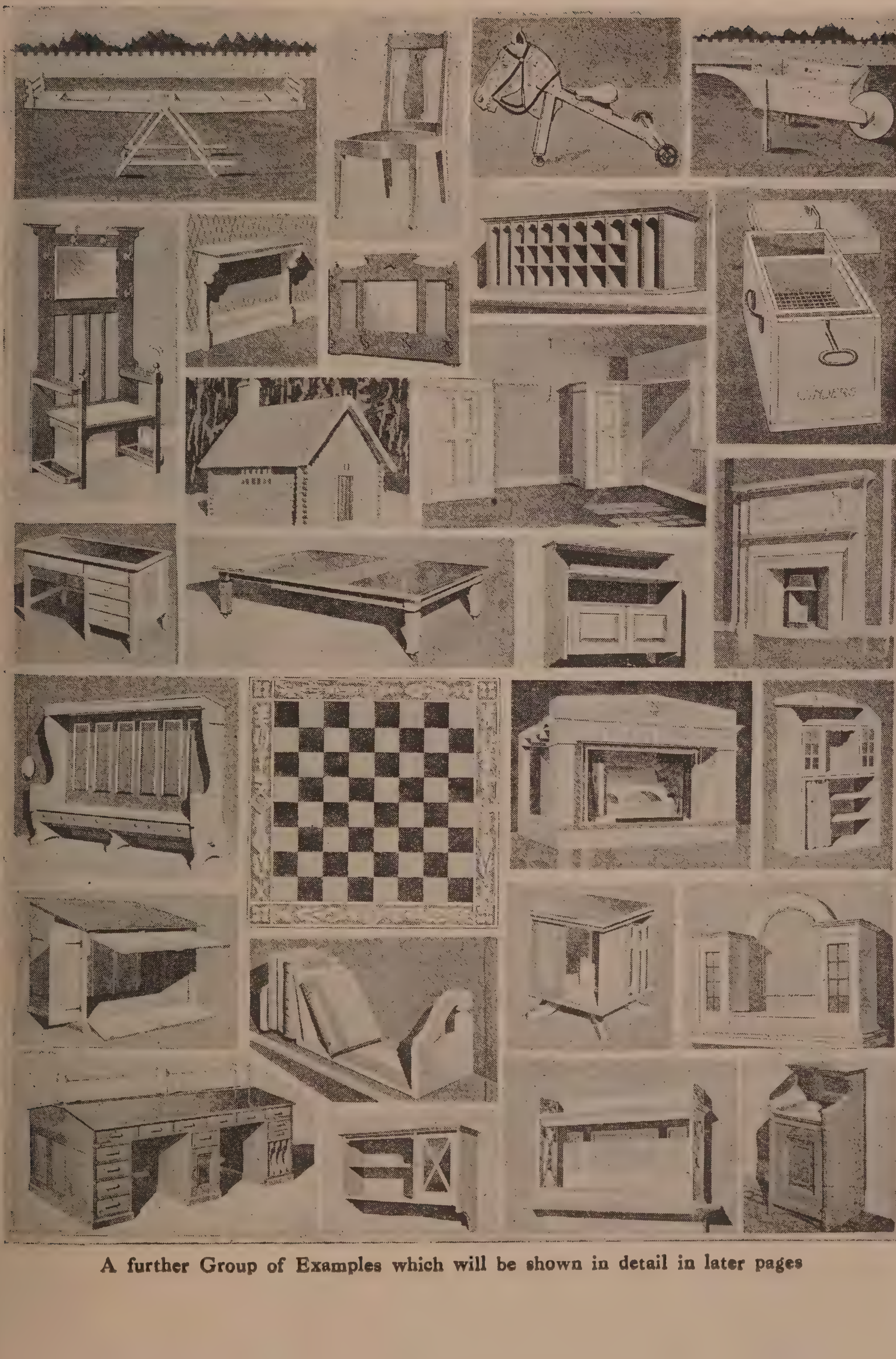
Special attention is given to the fixing of locks, hinges and other metal fittings, many of which require much skill in their fitting and adjusting and call for the use of special tools.

Moulding, mitre cutting, picture framing, gluing, tool making and toy making are explained. Timber—its



Loose-seat-Armchair in Hepplewhite Style

varieties, measurement, defects, characteristics, stock sizes and purchasing—is fully described with a view to enabling

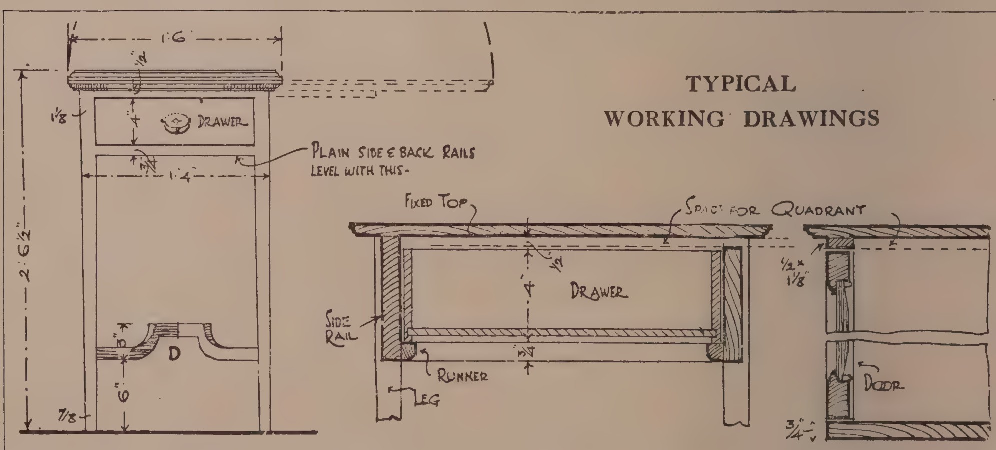


A further Group of Examples which will be shown in detail in later pages

the reader to select the best timber for any job and to purchase and use it economically.

In large workshops woodworking machines are much used at the present time, but notwithstanding this fact every good craftsman requires to know how to use the hand tools. Though machines will plane and saw and mortise, the workman still often does these operations by hand even in a machine shop, and his skill as a craftsman depends mostly on an expert knowledge of the processes dealt with in this book. But to show the relation of machine work to hand work and to make this treatise complete for the professional woodworker a chapter on wood-working machines is included towards the end of the book.

In order to make the book complete and enable the reader to carry his work through from the beginning right to the finished article, chapters are included on inlaying, carving, turning, upholstering, fuming, polishing, painting, enamelling, varnishing, etc.



The Workshop and its Equipment

Arrangement of Small Workshop.—The workshop at home is generally a spare room, maybe a surplus bedroom or a room in the basement, but failing the necessary accommodation in the house, a small shed is often erected, as will be described on later pages.

A general view of a room equipped as a small workshop is presented by Fig. 1. The two windows shown help to make a well-lighted and ideal workshop. Fig. 2 is a plan of a similar room measuring about 12 ft. by 9 ft.

In cases where it would be more desirable and convenient to have a workshop erected in wood the same plan would serve, the wall thickness, of course, being less, and the dimensions of the workshop being modified to suit requirements. A specially built workshop could have a skylight.

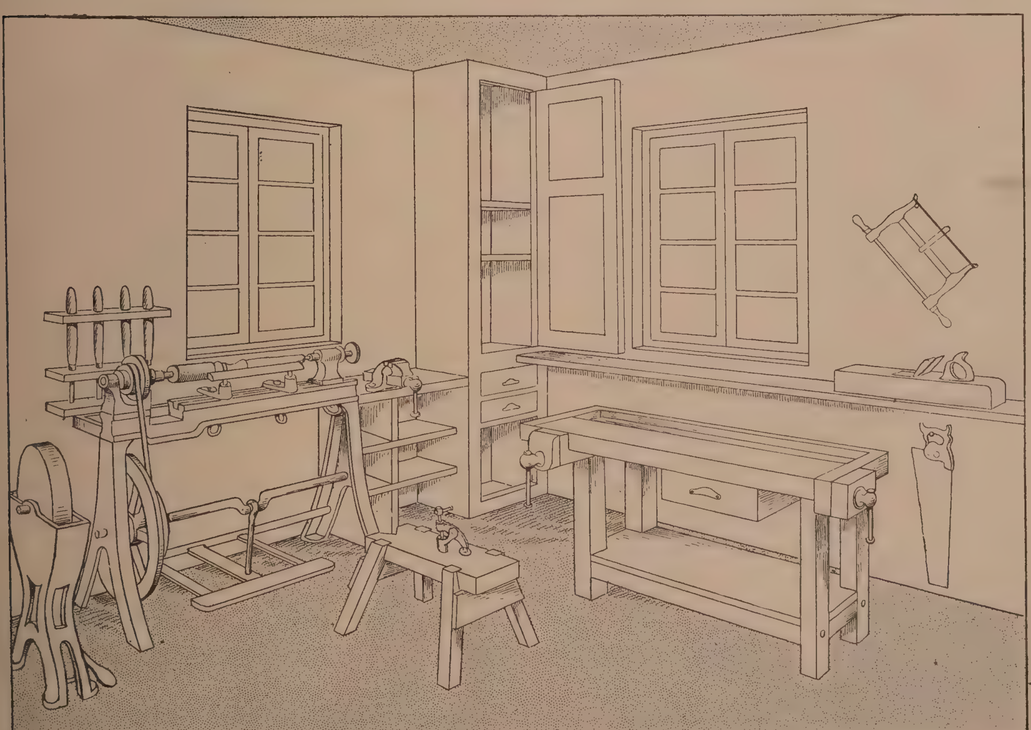


Fig. 1.—Typical Small Workshop

Lighting the Workshop.—Windows facing north or east are usually preferred, but where this scheme is rigidly carried out to the exclusion of other windows the workshop is very cheerless, and such a system should therefore be avoided when possible. Where a workshop has skylights, these should be fitted with blinds so that the direct rays of the sun may be kept off the work or the operator. Artificial lighting may be by electricity, gas, acetylene, or oil, the first-named being the best and the last the worst. The light should be so arranged that the worker faces the light more or less, and therefore does not cast a shadow on his work.

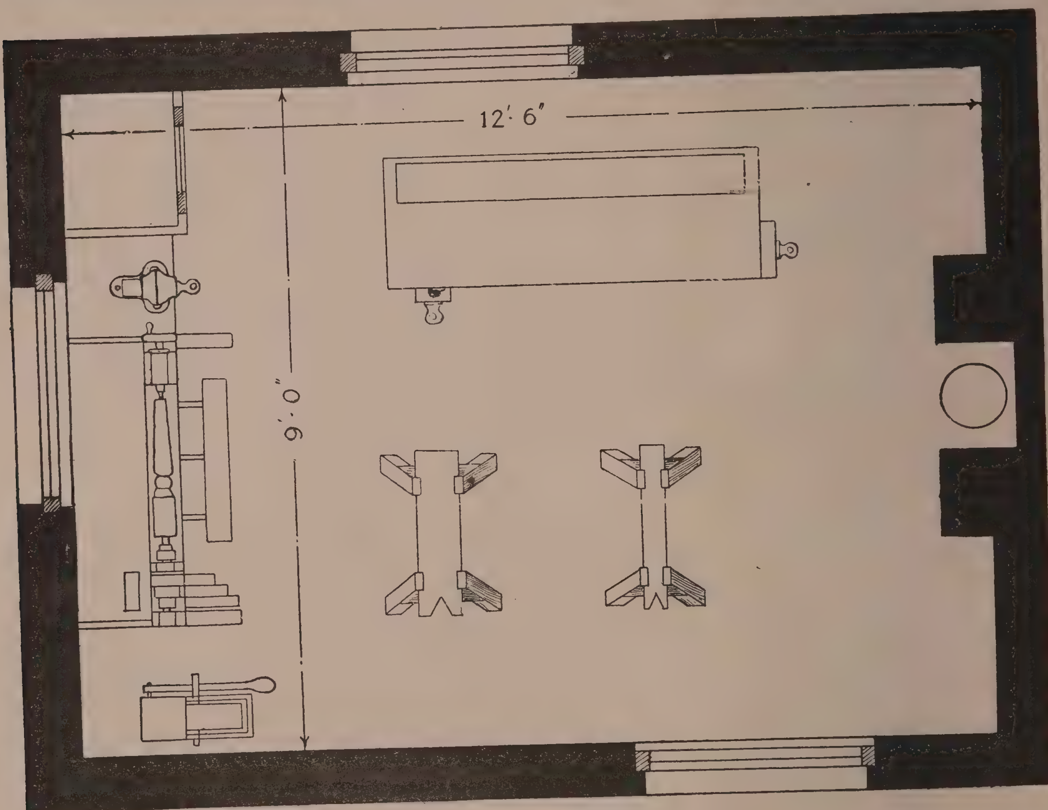
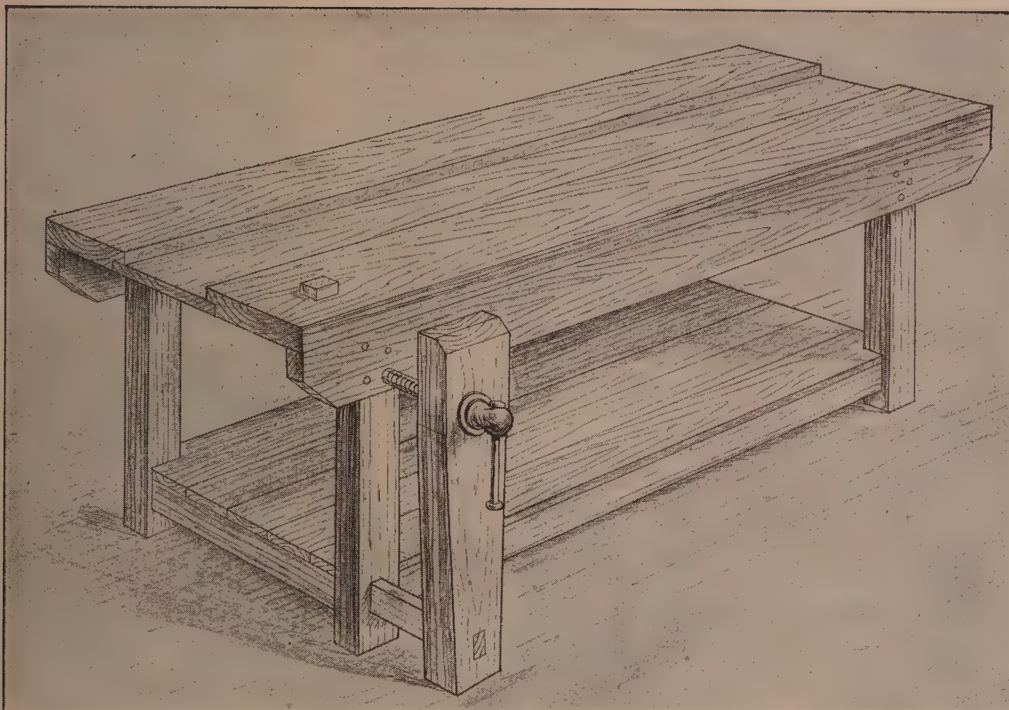


Fig. 2.—Plan of Typical Small Workshop

BENCHES

Suitable Timber.—A common form of bench is shown in Figs. 3 to 9, and for general purposes is best constructed of red or white deal throughout. The advantage of a soft wood top is that, although more readily damaged than one of hardwood, it can be easily trued up providing that it is sufficiently thick for the purpose. The type of bench shown is designed for heavier and perhaps rougher work than those about to be described. The benches, shown by Figs. 10 to 24 should preferably be built of hardwood with the exception of the well-board which may be of deal. Suitable hardwoods are beech and sycamore and even birch. The legs, rails and other parts of the frame may also be of hardwood, although good red or white deal would be found quite suitable both in strength and durability for these parts. If hardwood is used, some of the scantlings



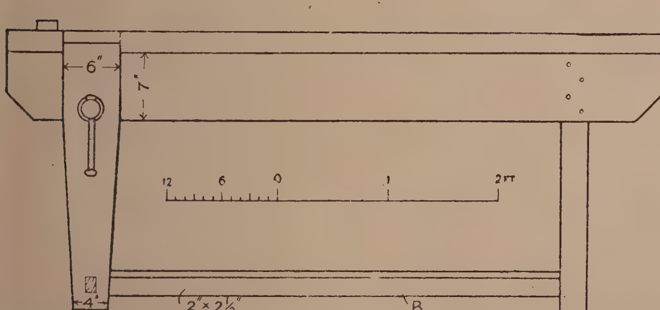


Fig. 4

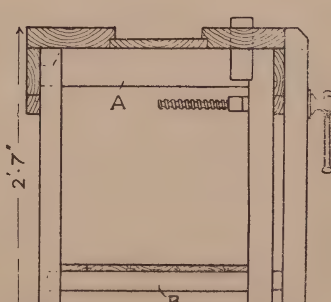


Fig. 6

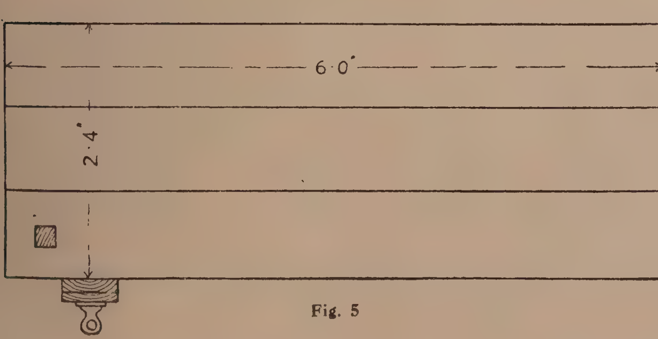


Fig. 5

Figs. 3 to 6.—Perspective View and Elevations and Plan of a Common Type of Bench — Trough-top Bench with Leg Vice

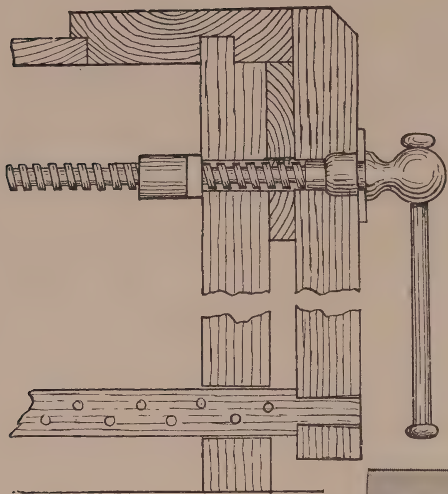


Fig. 7.—Method of Fitting Iron Bench Screw

could be less in size than those shown in the illustration.

A Common Type of Bench.—The common form of bench provided with a platform (*see* Figs. 3 to 9, already referred to) is fitted with the "Dolly" form of vice, a leg vice of which the cheek is vertical and has a steel screw with box and runner below with pinholes and iron pin for adjustment. The top is formed of two 9 in. by 2 in. deal boards, the lower inner edges of which are rebated to receive a board 11 in. by 1 in. which forms the well or trough. Three of the legs are made of 3 in. by 2½ in. stuff, but the leg to which the vice is attached is stouter—4 in. by 2½ in. It is very important that this leg should have a tenon at the upper end fitting into a mortise made in the underside of the top, as illustrated in Fig. 8, so that when work is screwed up in the vice the leg cannot be pulled forward by the action of the vice; if this is not done, after a time the leg and side of the bench are gradually forced forward, even when the top is strongly screwed to the side, so causing the latter to split. The top ends of the legs should be mortised and haunched as shown in Fig. 8 to receive the bearers (A, Fig. 6). The lower ends of the legs should be connected to the rails by ordinary stub-mortise and tenon joints, and the platform should be made of ¾ in. grooved and tongued boarding, machine-prepared floor-boarding being suitable for this purpose. The construction of the bottom of the runner and cheek will be clearly understood from Fig. 9. An enlarged sectional detail of the arrangement for fitting and connecting the iron screw is given by Fig. 7 on this page.

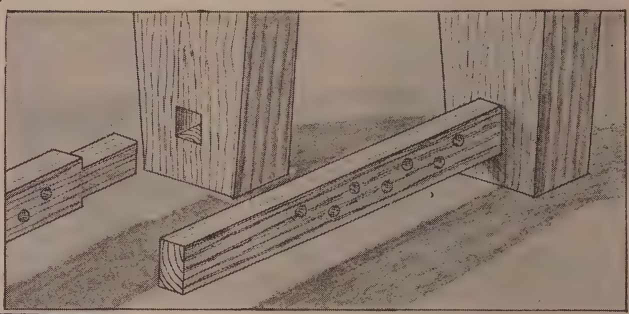


Fig. 9.—Fixing Runner to Cheek of Vice

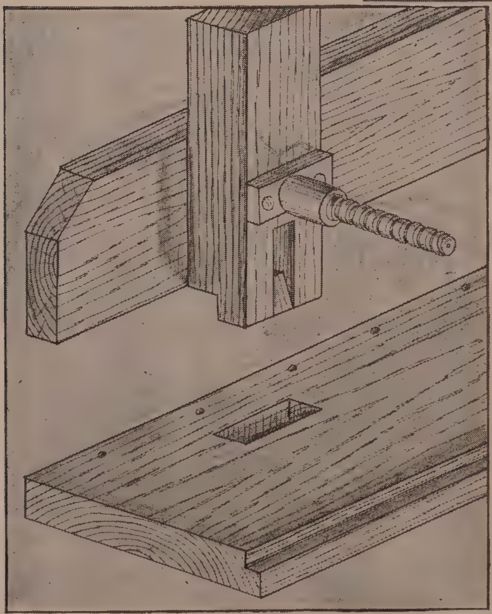


Fig. 8.—Construction of Top of Leg

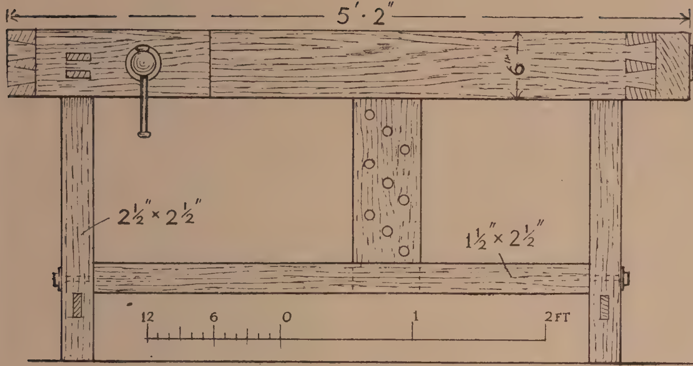


Fig. 10.

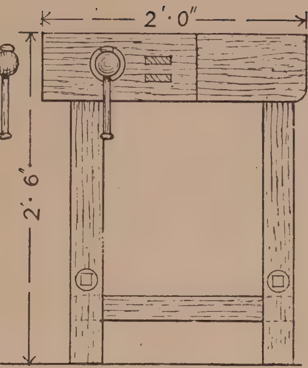


Fig. 11.

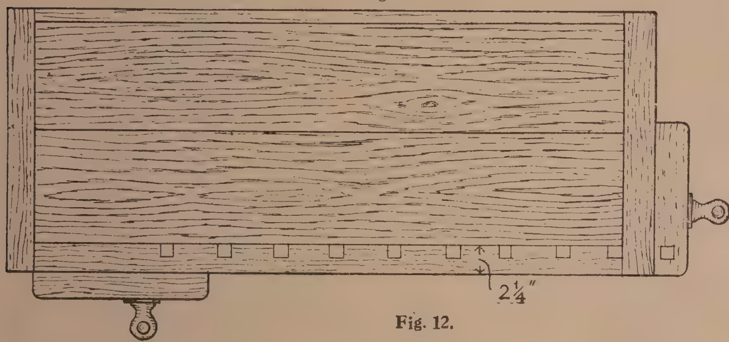


Fig. 12.

Figs. 10, 11 and 12.—Front Elevation, Side Elevation and Plan of Cabinet-maker's Bench with Peg-board

Fig. 13 (*below*).—Sketch showing Construction of Cabinet-maker's Bench

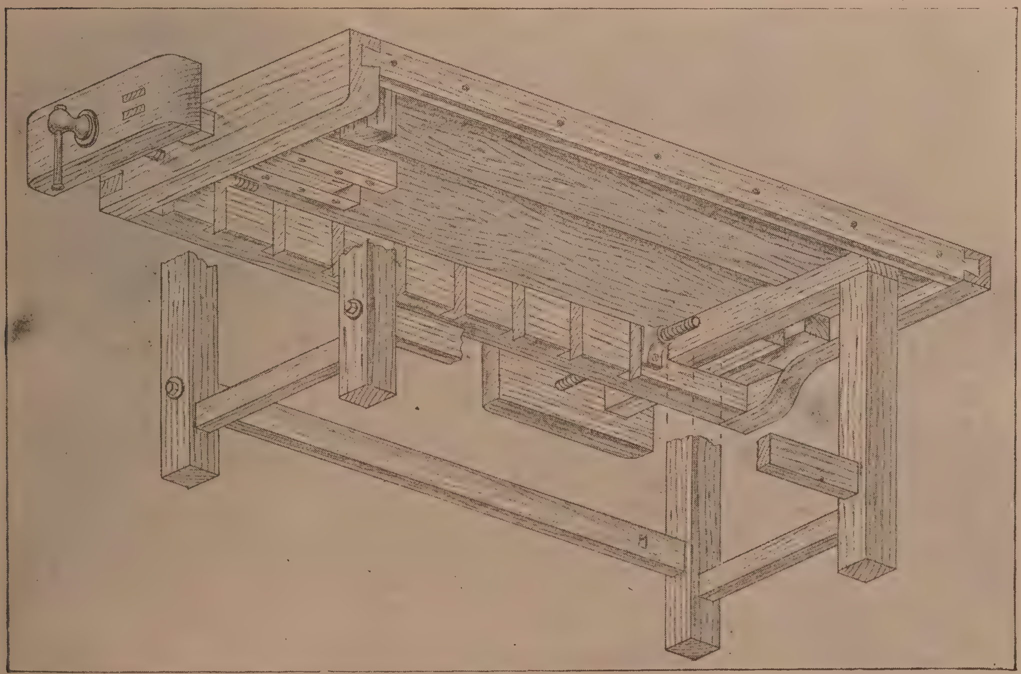


Fig. 13.

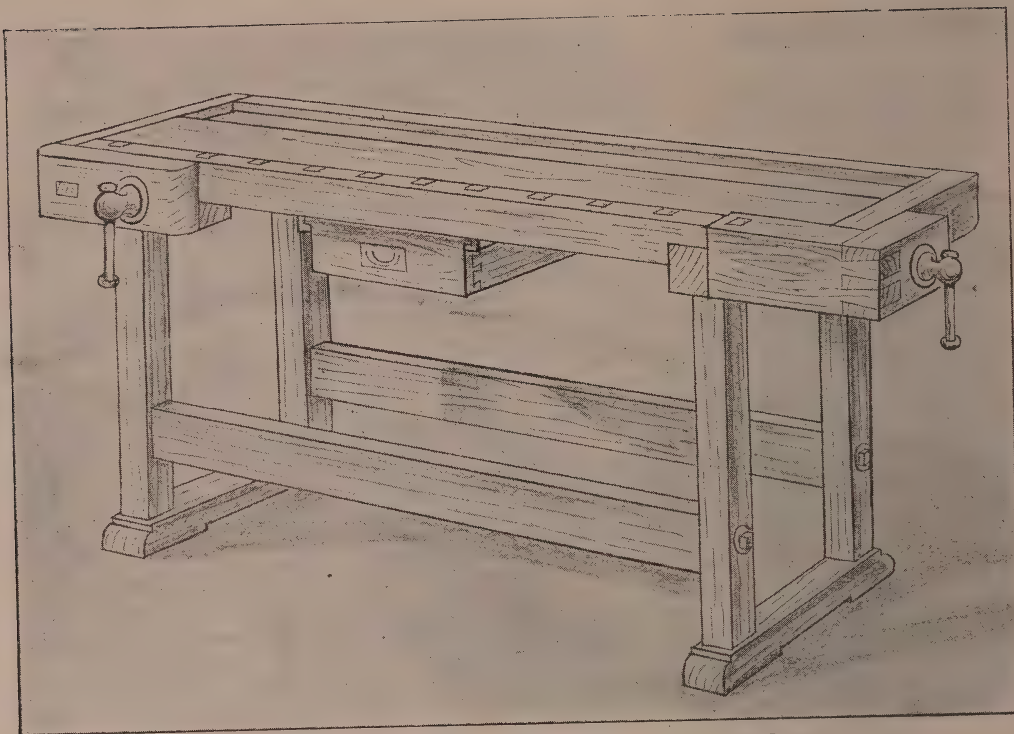
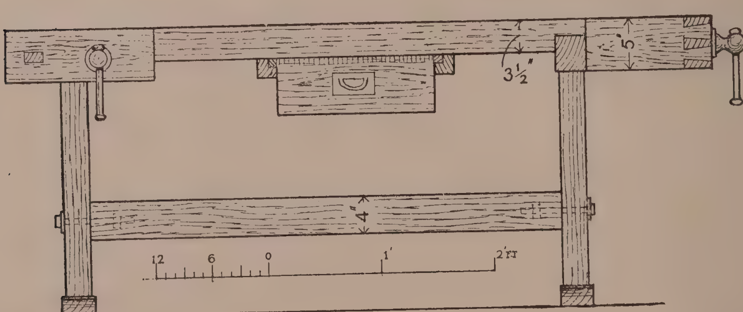


Fig. 14.—Sketch of Cabinet-maker's Bench with Tool Drawer



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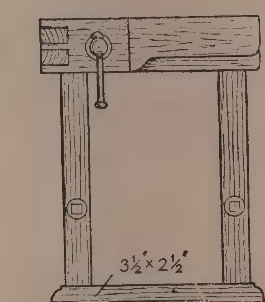


Fig. 16.

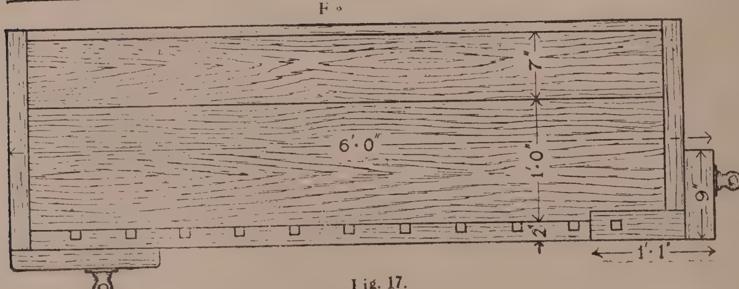


Fig. 17.

Figs. 15, 16 and 17.—Front Elevation, Side Elevation and Plan of Bench shown in Sketch above

Cabinet-maker's Bench.—One form of cabinet-maker's bench is illustrated by Figs. 10 to 13. The top is constructed as follows : The two end pieces and the front cheek (which has the slots made in it for the stop) are dovetailed together at the angles, as shown in Figs. 10 to 13. The back piece is 1 in. thick and is lap-dovetailed into the end pieces, as shown at Fig. 13. The planing board and well-board of the top are rebated together and their ends tongued into grooves made in the end pieces. The front cheek, after being notched for the stops, is glued and screwed to the planing board. The cross rails are connected to the legs by stub-mortise and tenon joints and fixed wedged. If desired, as an alternative arrangement, the tenons could go right through and be pinned. The longitudinal rails have short stub tenons and are additionally secured by a bolt and nut, the latter being inserted in a mortise made in the rail, as clearly shown in Fig. 10. This method makes a very sound job, but, if desired, the old method of making a long tenon pass through the mortise and securing with a key wedge may be adopted.

A peg board for holding long pieces of timber for planing is shown fixed to the front of the bench (*see* Fig. 10). When a long piece of board is screwed up in the vice at one end, the other end is liable to drop when the pressure of the plane is applied, and to keep this end up a peg is put in one of the holes shown and the board rested on it. A number of holes are necessary to accommodate various widths of work.

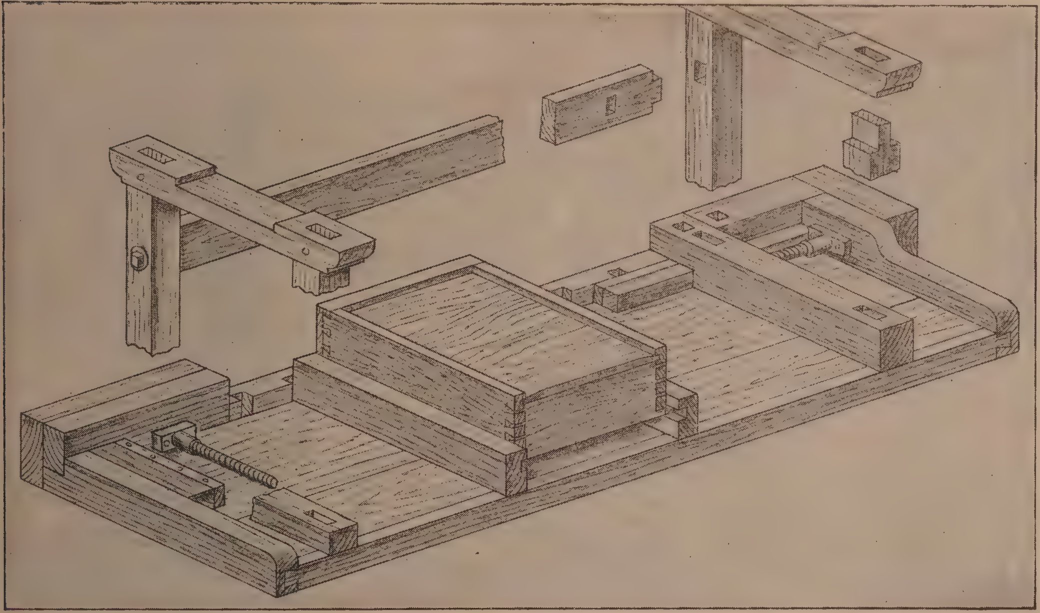


Fig. 18.—Sketch showing Construction of the Bench illustrated on preceding page

Another example of a cabinet-maker's bench is shown in Figs. 14 to 18. It is fitted with an end vice for cramping up and holding work. The construction is generally similar to the preceding bench, but different in one or two details. The peg board is omitted, but a drawer for tools is shown. On the sides of the drawer are screwed small fillets which slide in grooved runners screwed to the underside of the bench. The legs are supported on base pieces which also act as end rails.

Portable Bench.—Figs. 19 to 23 are

illustrations of a small portable bench which will be found very suitable where the use of a bench is only occasionally required and a proper workshop is not available. The top consists of a planing or working board and a well. Sizes for general purposes are figured on the illustrations. Two ledges are screwed to the underside of the top, and to these the top rails of the leg framings are attached with strong 3-in. butt hinges. The drawings clearly show the construction of the leg framing. A block of wood is screwed to the top; this has a hole bored through it, as have also the upper ends of the struts, and thus the three parts can be held firmly together by a bolt and nut, a wing or butterfly nut being the most convenient. The lower ends of the struts are notched over the

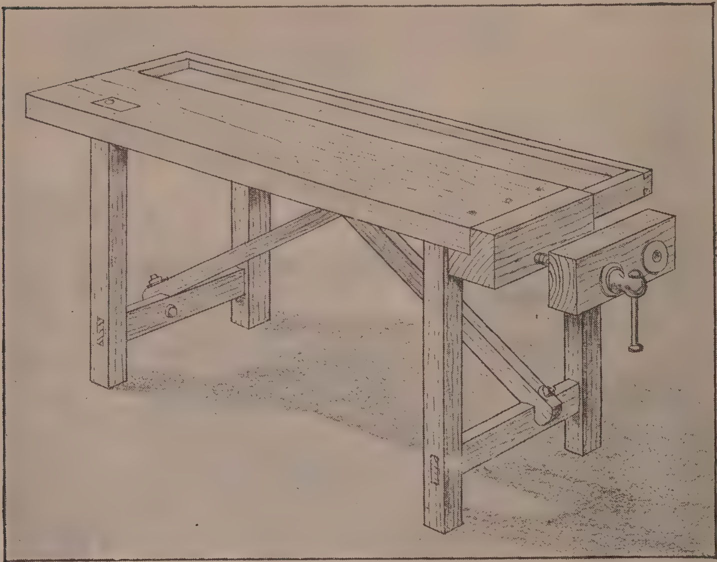


Fig. 19.—Sketch of Portable Bench

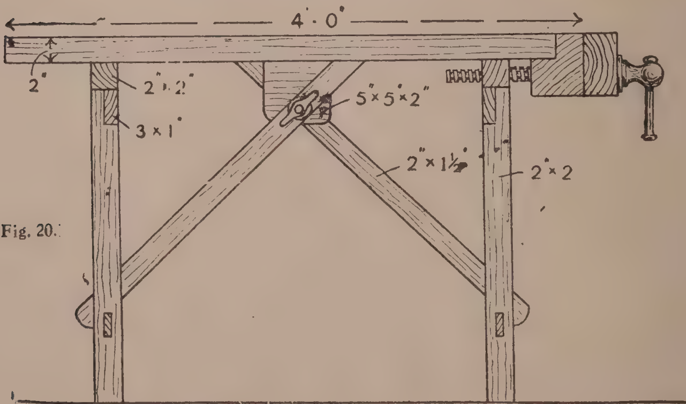


Fig. 20.

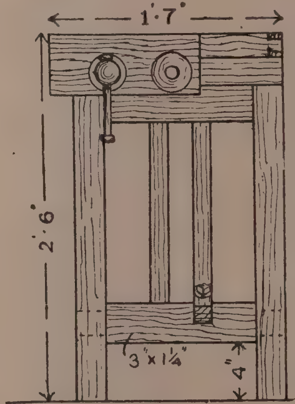


Fig. 21.

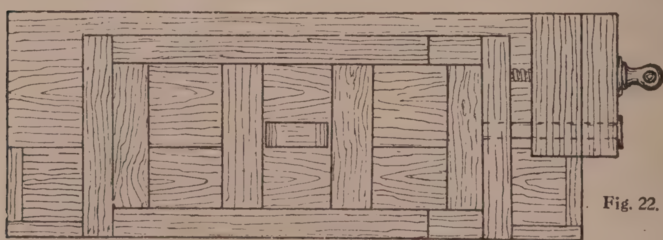
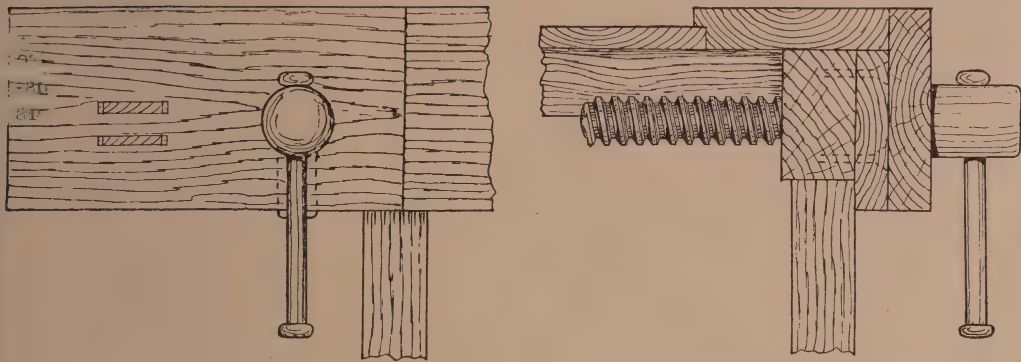
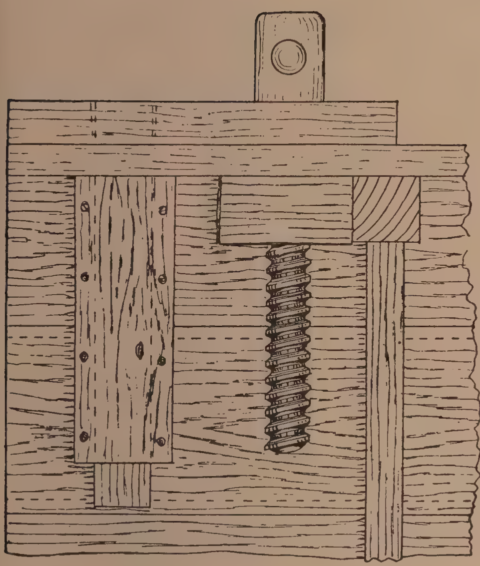


Fig. 22.

Figs. 20, 21 and 22.—Front Elevation, Side Elevation and Plan of Portable Bench





Figs. 24, 25 and 26.—Front Elevation, Vertical Section and Plan Looking Up, showing Method of Fitting a Wooden Vice. (*See* Fig. 27.)

bottom side rails of the legs and bolted to them, the bolts being preferably cranked as shown in the drawing.

Bench Fitted with Drawer and Cupboard.—The bench, shown by Fig. 28, is an extremely handy form, provided with three drawers and a cupboard. One or two of the drawers can be fitted up to hold chisels, gouges, bits and other of the smaller tools. The bottom drawer can be made to contain hollows, rounds, bead planes, metal planes and other of the small planes.—The cupboard can be fitted with shelves, so as to accommodate jack plane, trying plane, saws and other of the larger tools.

If the bench is made a fair size, say

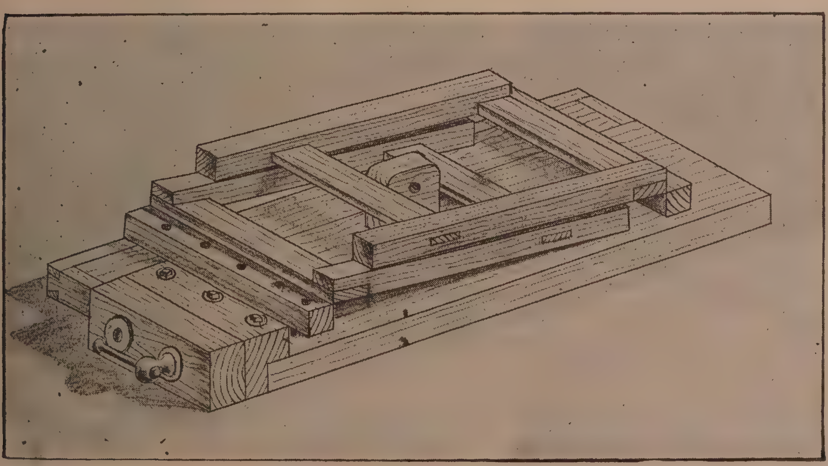


Fig. 23.—View of Underside of Portable Bench, showing Legs Folded Up. (*For details, see preceding page*)

about 5 ft. 6 in. long and 2 ft. 3 in. wide, it will contain all the tools for ordinary requirements, without any tool chest, cupboard, or outside rack being necessary. This bench will be found especially useful and suitable for anyone who has not a proper workshop and has to make use of a room which, during part of the day, has to be employed for other purposes. By using a simple iron stop that can be screwed level with the top and a small iron vice as illustrated it is possible for the bench to form a piece of furniture when not in use by the woodworker. The vice can be fixed to the underside of the top with two or three bolts and wing nuts, and consequently can be quickly detached.

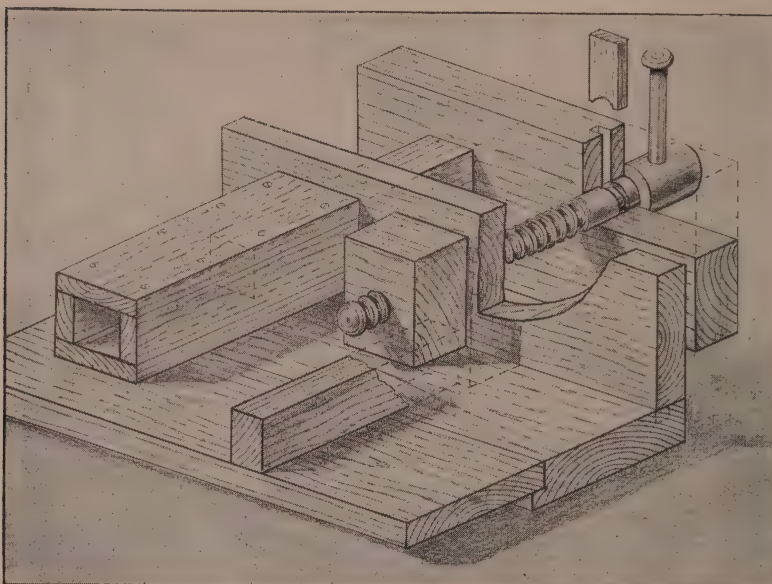


Fig. 27.—Sketch showing Method of Fitting Wooden Vice. (*See* Figs. 24 to 26)

Bench Vices.—The vice illustrated by Figs. 24 to 27 represents one constructed almost entirely of wood, the screw and nut usually being made of beechwood. The cheek and runner are best made of some kind of hardwood, all the other parts being of red and white deal. Formerly the wooden screw type of vice was more used than any other, but it has been super

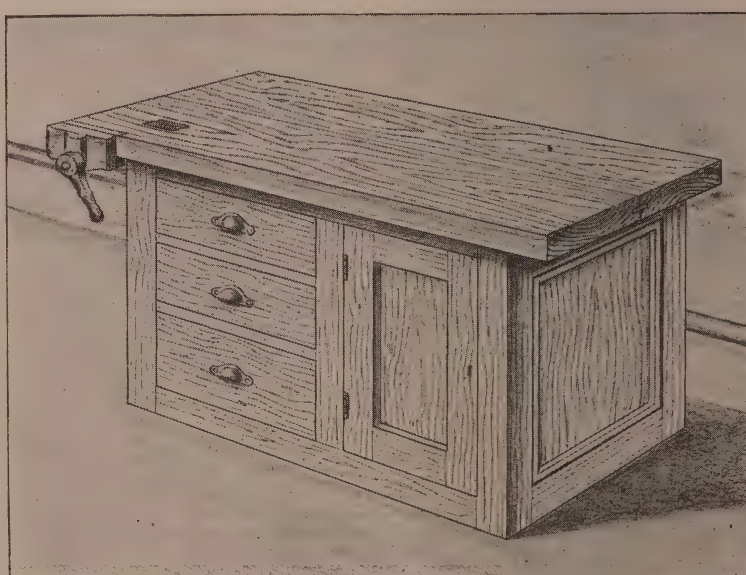


Fig. 28.—Sketch of Bench Fitted with Drawers and Cupboard

seded since the introduction of metal screws and nuts (or boxes). The drawings fully and clearly show the construction. The sizes of the parts vary, of course, according to requirements. The screw and cheek are held together by means of a hardwood key which is inserted in a mortise made from the bottom edge of the cheek. The end of the key is hollowed so as to fit into the groove turned in the shank of the screw; this is shown in Fig. 27.

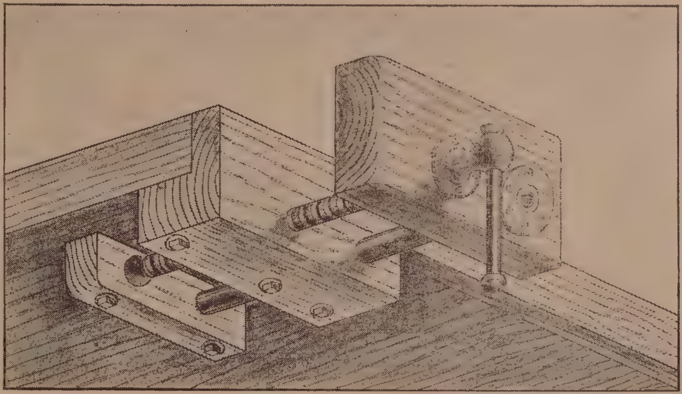


Fig. 29.—Vice with Steel Screw and Wooden Jaws

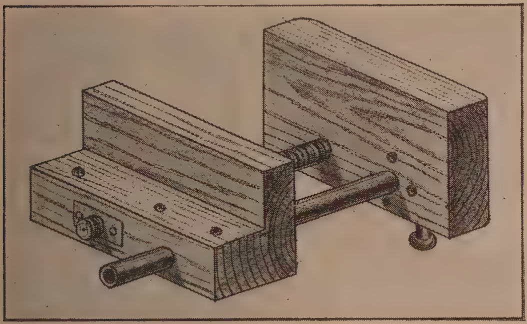


Fig. 30.—Detail of Vice (looking from Back)

The vice illustrated by Figs. 29 and 30 is an improvement on the one above described and illustrated. It is provided with a steel screw and nut and a runner is formed of a piece of strong $\frac{3}{4}$-in. to $1\frac{1}{8}$-in. gas pipe or steam tubing, screwed at one end so as to fix into a 3-in. or 4-in. iron flange, in which four to six holes have been drilled and countersunk to receive stout screws. The flange may be more firmly fixed to the cheek by using range screws (or bolts) and securing with a nut at the back of the cheek, holes being made to receive the bolt heads so that they sink a little below the surface. These are indicated at Fig. 30. The block is fixed to the top of the bench by three coach bolts. Bolts and nuts can be used, in which case the heads are sunk $\frac{3}{8}$ in. below the surface of the top and pieces of wood fitted in the holes, glued and planed off flush with the top surface. This vice, if carefully made, will be found to work parallel, because of the strong connection between the runner and cheek. It is quite suitable for either a side vice or end vice.

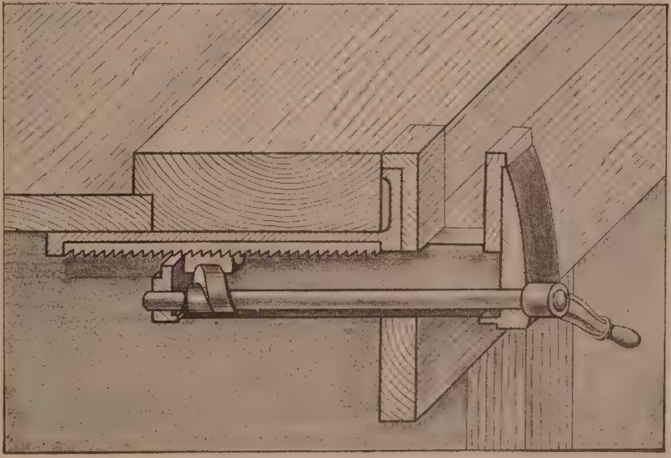


Fig. 31.—Instantaneous-grip Vice

Instantaneous-grip Vice.—Fig. 31 shows a type of instantaneous-grip vice which has been much used for many years. It is very strong and serviceable, although much more expensive than home-constructed vices. The action is as follows: Upon raising the handle, the bar and screw cam is turned; the diameter of the latter gradually decreasing causes the semi-nut (which has a rack on its upper side) to lower and disengage from the long rack, whereupon the front jaw slide can

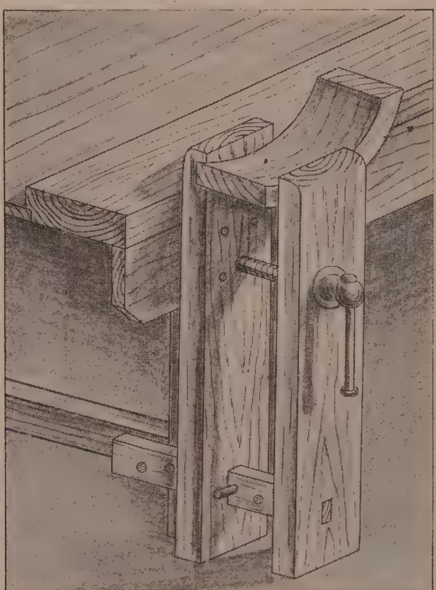


Fig. 32.—Useful Vice for Curved Work

be drawn out the desired distance; the work is then placed in position and the jaw pushed close to it. When the handle is pressed down, the cam raises the semi-nut in contact with the rack; and the further movement of the handle forces the jaw to the work by the screw action of the cam. The top edges of the jaw are kept below the surface of the planing plank about 1 in., this allowing of both of the jaws being lined with hardwood, which is secured to them by screws. This wood lining prevents the edges of the tools being damaged by coming into contact with the metal. Photographic illustrations in later chapters show a different type of instantaneous-grip vice.

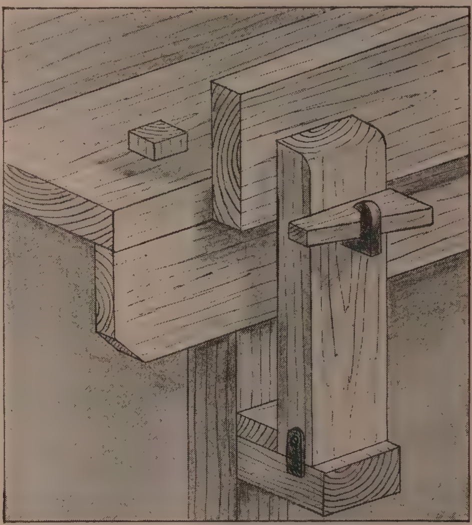


Fig. 33.—Improvised Vice for Small Work

Other Kinds of Vices.—For curved work a vice whose jaws stand above the level of the bench top is very useful, as shown in Fig. 32; it is made with two long cheeks and a runner at the bottom with holes and pins for adjustment, the

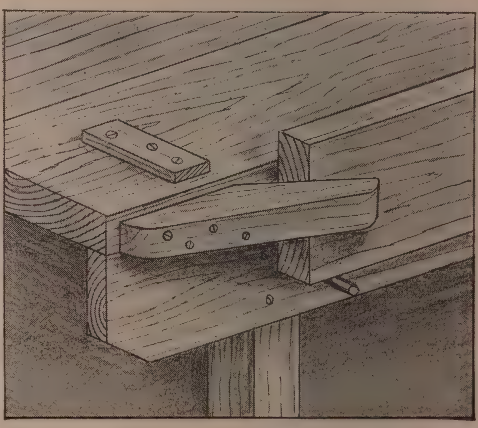


Fig. 34.—Cleat for Holding Boards whilst Planing, etc.

inner cheek being screwed to the side of the bench.

Fig. 33 shows an improvised form of vice which will be found useful for holding small work and when planing the edges

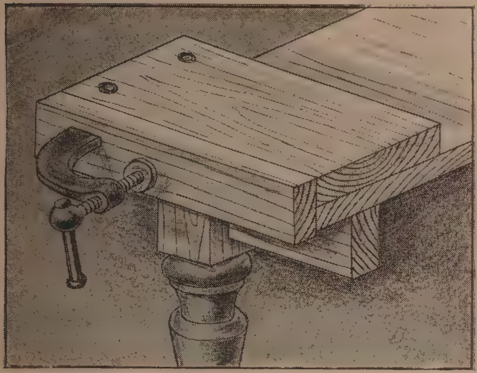


Fig. 35.—Clamp for Use on Table

of boards and for similar operations. A long iron bolt is forged into a hook form at its head end as shown. A hole is bored through the cheek of the vice large enough for the shank of the bolt to work in freely. The side of the bench and leg are bored

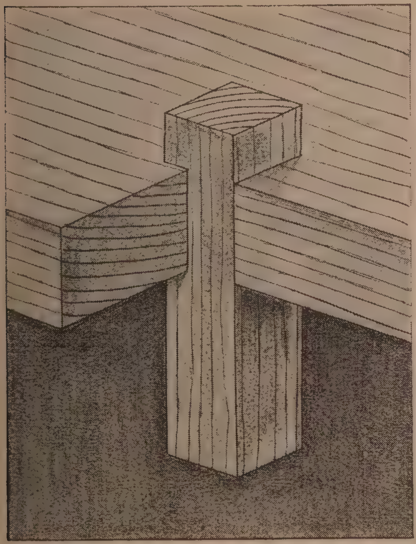


Fig. 37.—Ordinary Bench Stop

so that the bolt passes through and is fastened at the back of the leg with a nut. A block is fastened to the leg of the bench for the cheek to rest upon, and a piece of iron screwed on each side of the cheek will prevent the cheek from slipping side-

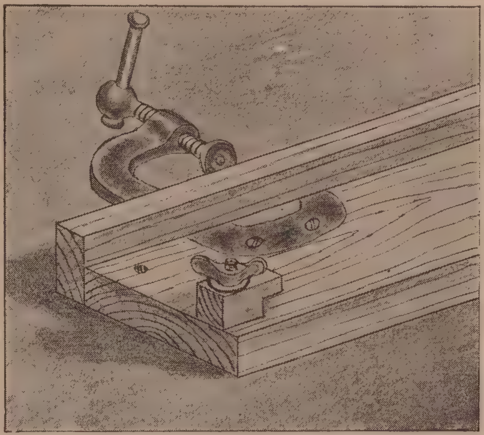


Fig. 36.—Underside of Clamp

ways. For tightening the work a hardwood wedge is driven between the vice cheek and the forked nut head. The bottom of the cheek can be adjusted by

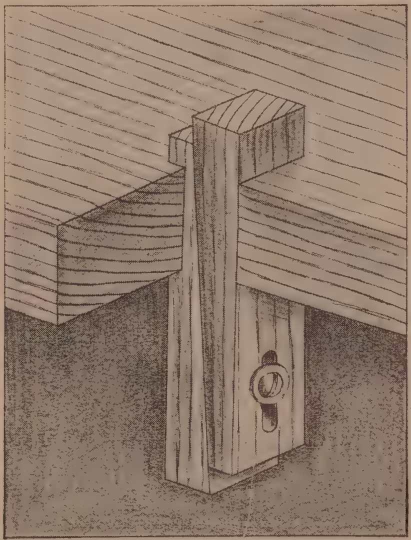
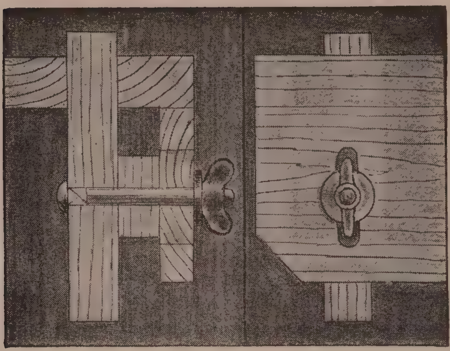


Fig. 38.—Wedge Bench Stop

pieces of wood varying in width. Several wedges of different size will be found useful for different thicknesses of work.



Figs. 39 and 40.—Vertical Section and Front Elevation of Adjustable Bench Stop. (*See* **Fig. 41** *at foot of page*)

Fig. 34 shows a cleat, which is a triangular-shaped piece of wood, screwed to the top edge of the bench; it will be found very useful for holding boards, etc., the edges of which are to be planed. This arrangement will hold the work fast as long as there is a pressure forward, but any back pressure will, of course, directly loosen the work.

In cases where it is not desirable or convenient to set up an ordinary bench and it is only required to do light work on a table, and without injury to it, the contrivance shown by Figs. 35 and 36 will be found convenient. A board about 9 in. wide and 2 in. thick and long enough to project about 3 in. at each end over the table top is required; a piece the same length and about 4 in. wide and $1\frac{1}{2}$ in. thick is nailed or screwed to the board as indicated in the illustrations. Before fixing the edge piece, a strong G-cramp should be passed through a mortise made in it, the lower end of the cramp being fitted into a recess made in the underside of the planing board so that the surface of the metal is a little below that of the board. The lower end of the cramp should have been previously drilled and countersunk so that it can be firmly secured to the board with a couple of stout screws. The board may be fixed to the table top by four hardwood buttons or clips and bolts with wing nuts, one of which is shown in Fig. 36.

Bench Stops.—The simplest form of bench stop is made by screwing a thin strip to the bench top as shown in Fig. 34. This form is especially useful when planing short wide boards, such as panels, etc.

Fig. 37 shows a simple form of stop which has probably been used more than any other kind. It is generally made from a piece of hardwood about 2 in. sq. fitting tightly into a mortise made through the top of the bench. To prevent splitting the top, care should be taken to make the breadth of the mortise the same as the stop. The two sides of the mortise having the end grain

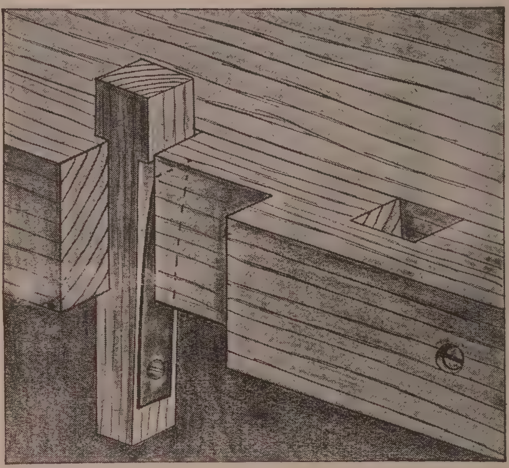


Fig. 42.—Spring Stop

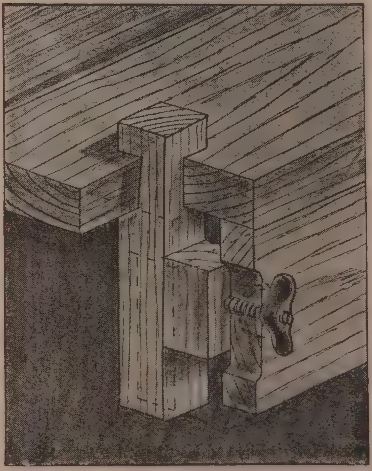


Fig. 41.—Sketch showing Adjustable Bench Stop

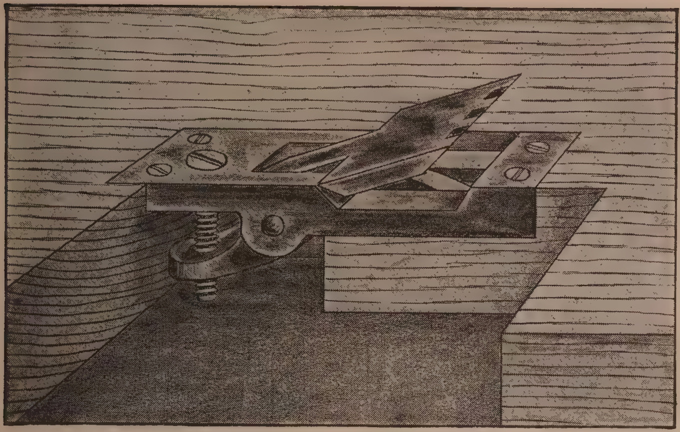


Fig. 43.—Metal Stop

should fit tightly to the stop. The adjustment is made by simply striking the stop upwards or downwards with a mallet.

Fig. 38 is an improvement on the last-mentioned kind of stop. It is formed of a pair of wedges ; to keep them together and allow them to slide, a slot is made in the front portion so that the shank of a round-headed screw can work freely in it, the screw holding firmly in the back wedge. A washer, as shown, will prevent the head of the screw from catching in the slot.

An adjustable stop that has proved most satisfactory for general use is shown by Figs. 39, 40 and 41. A slot is made in the side of the bench, so that a ½-in. bolt can work freely in it, the bolt passing through a block and the stop which have been bored to receive it. A wing nut (with a washer at the back) is fitted to the screwed end of the bolt.

Fig. 42 is a sectional view of a spring stop. This kind is largely used by cabinet-makers, and especially for benches with end vices, as by using two stops of this kind a piece of work can be firmly held between them and flat on the top of the bench. When holding work in this manner one stop is put in the bench top and the other in the end vice. The two stops are placed the proper distance apart and when the end screw is tightened the work is gripped between them.

Fig. 43 shows a cheap and effective form of metal stop. The view is given partly in section so as to show how the stop is fitted and fixed to the top of the bench. The stop piece, shown open and inclined, is raised or lowered by means of a screwdriver inserted in the head of the large screw. The general action will be clearly understood from the illustration.

Another good form of a metal adjustable stop, known as Morrill's pattern, is shown by Fig. 44. The view is given partly in section so as to show the fitting of the stop to the bench top, ready for screwing. The illustration clearly shows the construction of the stop.

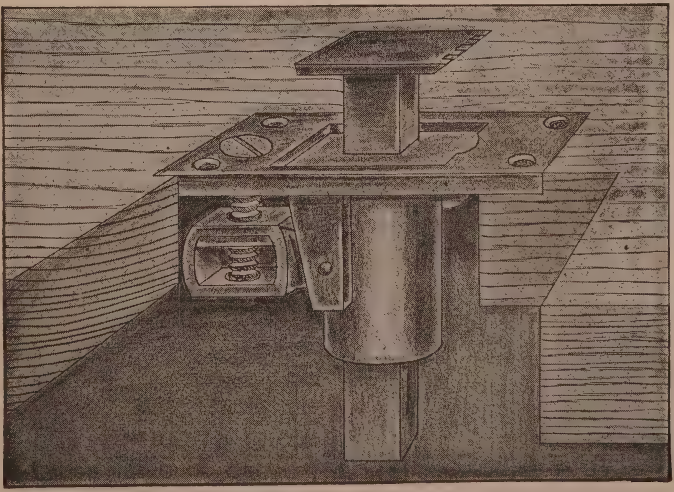
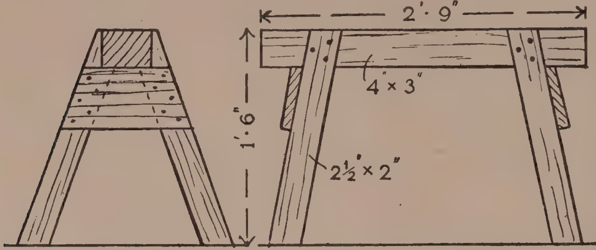


Fig. 44.—Metal Stop : Morrill's Pattern

The disadvantages of metal stops are that they are liable to get choked with



Figs. 45 and 46.—Front and End Elevations of Sawing Stool

sawdust and chips of wood, and, secondly, tools are often driven against them and their edges damaged.

SAWING AND OTHER STOOLS

Figs. 45 to 48 illustrate the ordinary strong form of stool which is very useful for sawing upon and for a great variety of other purposes. It is generally made of scantling, the legs being from 2 in. by 2 in.

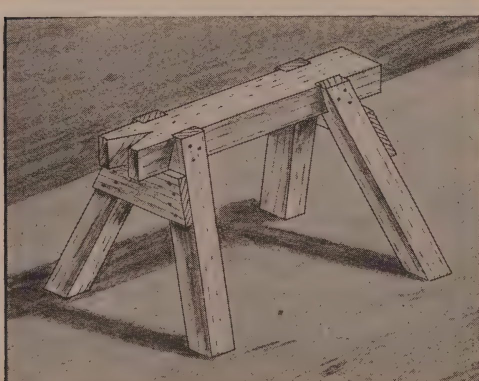


Fig. 47.—Sketch of Sawing Stool

to 3 in. by 3 in. and the top 3 in. by 2 in. to 4 in. by 3 in. The legs should incline both ways as shown.

The upper ends of the legs of the stool should be cut as shown and the edges of the sides notched out to receive the legs, these being nailed or screwed to the top. Fig. 48 fully shows this construction.

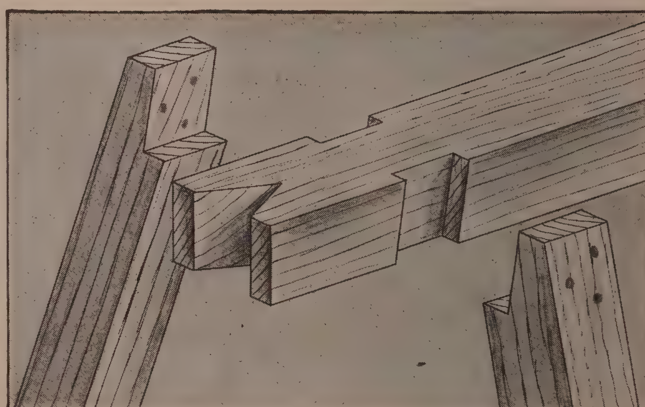


Fig. 48.—Method of Fixing Legs of Sawing Stool

The bracing piece at each end should be cut to fit and then nailed or screwed to the legs. The bottom ends of the legs should be scribed ("scribing" will be described in detail later), and then sawn to fit the floor. For general purposes red or white deal will be found a quite suitable material for stools.

Fig. 49 shows a somewhat similar stool but having a much broader top in which a holdfast or other form of cramp can be fixed (*see also* Fig. 1 on an earlier page). This cramp will allow of broad material being held and more conveniently sawn off, and will also be found serviceable for many other purposes.

Mortising Stools.—The making of small mortises can usually be done at the bench, but when a number of mortises of large size have to be made through material 3 in. to 5 in. wide they are more conveniently and quickly worked by using a mortising-stool, the ordinary kind of which is shown by Fig. 50. As will be seen, the edges of the legs run up and

project above the bed, forming "horns," and work placed on the bed between these can be held firmly if desired by pushing in a wedge, hand-tight, between the work and the horns. The size of the stool and sizes of materials will vary according to requirements. The legs may be from 2 in. to 3 in. thick and 7 in. to 11 in. wide; the bed may be 3 in. to 4 in. thick and 4 in. to 7 in. broad. The length may vary from 3 ft. to 5 ft.; height to top of bed about 1 ft. 6 in.

Stool for Small Work.—Fig. 51 shows a light and handy form of stool suitable for small work. It can be made of boarding $\frac{3}{4}$ in. to $1\frac{1}{4}$ in. thick and 6 in. to 9 in. wide. To make it rigid, a block is fixed in each inner angle, also two struts, as clearly shown in the illustration.

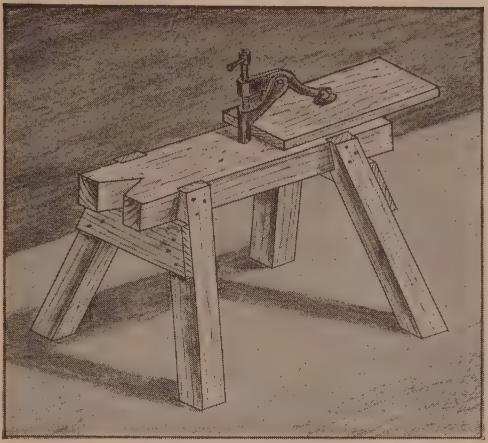


Fig. 49.—Sawing Stool with Wide Top

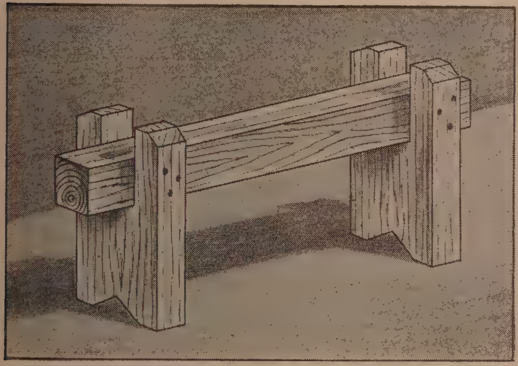


Fig. 50.—A Type of Mortising Stool

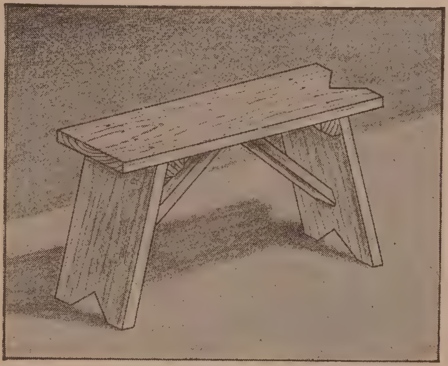


Fig. 51.—Handy Stool for Small Work

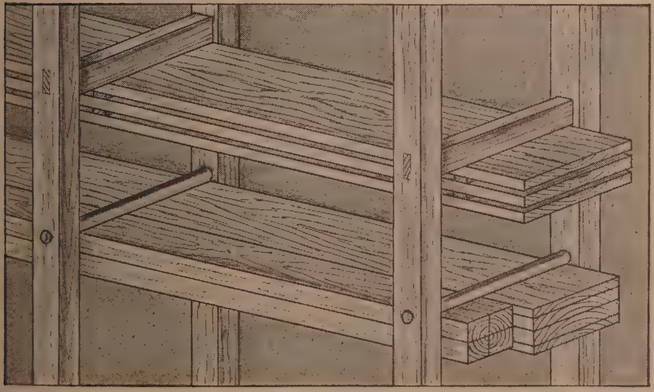


Fig. 52.—Timber Rack

TIMBER RACKS

Fig. 52 shows a usefu form of timber rack. It is made with vertical standards, from 3 in. by 3 in. to 4 in. by 3 in., mortised or bored to receive bearers, which may be pieces of round iron or old gas or steam piping (as shown in the upper part of Fig. 52), 1 in. to $1\frac{1}{2}$ in. in diameter; or they may be of timber, 2 in. by 4 in. or 3 in. by 4 in., with tenons fitting into mortises as illustrated.

Fig. 53 shows a much handier, and at the same time stronger, kind of rack. Holes are cut into the brickwork about 3 ft. to 4 ft. apart and $4\frac{1}{2}$ in. to 6 in. deep; pieces of T-iron, H-iron, or strong piping are inserted and held firmly in the wall by wedging it with pieces of tile or slate, and plastering with cement. It will be obvious that timber can be more quickly stacked or removed with this form of rack than with others.

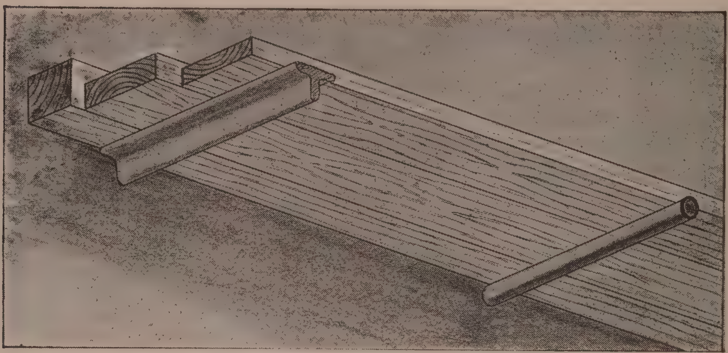


Fig. 53.—Timber Rack consisting of Metal Cantilevers

Timber is better if stacked with small strips of wood (called "skids") between the layers, as shown in the bottom part of Fig. 52, thus allowing the air to circulate all round the timber and enabling it to season better.

Sometimes boards are stacked edgeways, in which case the rack may consist of a horizontal bar with vertical strips fixed to it, the boards lying in the slots between the strips.

Tools for Measuring and Marking

RULES

THE common type of rule used by woodworkers is the four-fold "two-foot," of which two varieties are shown: Fig. 3, a cheap type; Fig. 4, with brass edge plates to the joints and also with bevelled edges. Figs. 5 and 7 show rules with slides for measuring board thicknesses, taking the depth of rebates, etc.

Woodwork measurements in subdivisions of an inch are given in eighths; twelfths, tenths, etc., of an inch are seldom used. Measurements in rough carpentry are considered accurate enough if given in eighths, but very often the phrases "bare eighth" or "full eighth" are used when the measurement is slightly under or above the division. Thus, if two carpenters were working together, one cutting whilst the other was fixing the work, one would observe to the other that he

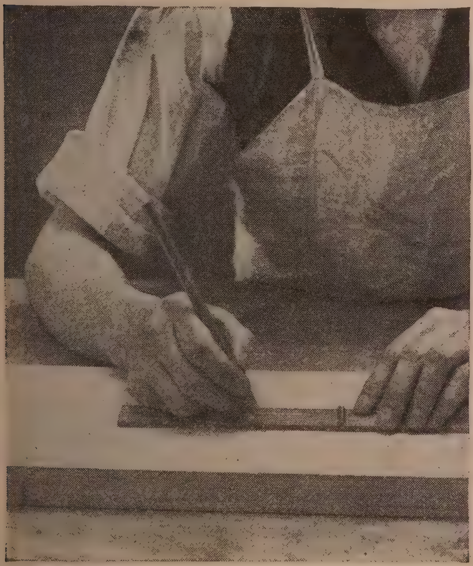


Fig. 1.—Transferring Measurement from Rule

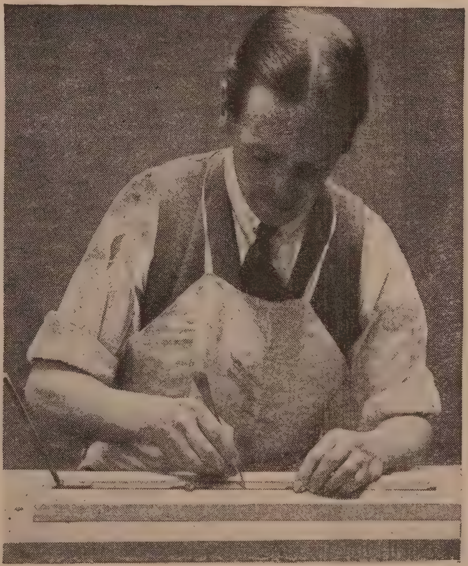


Fig. 2.—Accurate Measuring with Bevelled-edge Rule

wanted a piece of wood, say, "2 ft. 6⅝ in. bare." In cabinet work, finer measurements are required, and they are commonly given to the nearest sixteenth, "bare" or "full" if necessary.

The ordinary sub-divisions of each inch in a four-fold rule are therefore eighths, but in some rules other divisions and scales are given, particularly in bevel-edged rules as Fig. 4. The pivot joints of good-class rules are often divided into degrees so that the legs of the rule can be set at any angle, rules being commonly used to do the work of adjustable bevels. (*See* Fig. 9.)

The bevel-edged portions of the rule are not only useful because of the scales on them but also because the bevel leads to greater accuracy by bringing the divisions of the rule nearer the surface to be marked, as illustrated in Figs. 1 and 2. Of course, the non-bevelled rule can be turned on its edge for accurate marking, as in Fig. 11.

A few years ago the two-fold "two-foot" (Figs. 7 or 9) was largely used,

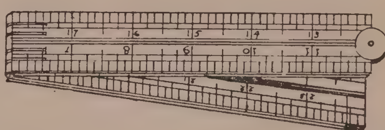


Fig. 3.—Ordinary 2-ft. Four-fold Rule

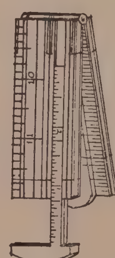


Fig. 5.—Rule with Caliper Slide

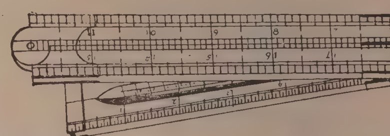


Fig. 4.—Bevelled-edge 2-ft. Four-fold Rule

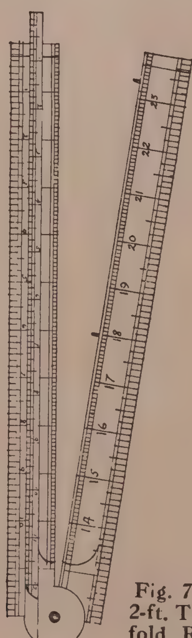


Fig. 7.—2-ft. Two-fold Rule with Slide

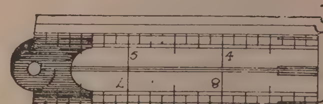


Fig. 6.—1-ft. Four-fold Rule

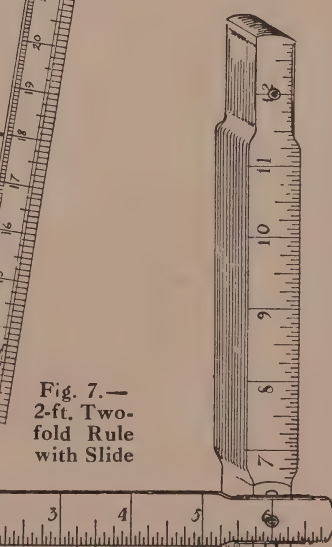


Fig. 8.—Stanley "Zig-zag" Rule

Fig. 9.—Two-fold Rule with Protractor Adjustment

but is now practically out of date owing to being clumsy for carrying about; however, it is convenient for bench work. On the whole, the ordinary four-fold "two-foot" with square edges is mostly used, and is found accurate enough for almost every purpose. Four-fold "three foots" or "four-foots" are preferred by some woodworkers. On the other hand, four-fold "one-foot" rules are shown in Figs. 5 and 6, the latter having a slide for obtaining the thickness of boards, etc.; Fig. 8 shows a Stanley "Zigzag" rule. Other types of rules are occasionally met with, some having slides for calculating or drawing geometrical figures, but these are not of much use.

Fig. 10.—Measuring-off a Board for Length

Fig. 11.—Accurate Measuring with Rule on Edge

Fig. 12.—Measuring Thickness of Board

Using the Rule.—Of course, there is little difficulty in using a rule, but one or two workshop hints will prove useful. There are two ways of measuring a length—roughly and accurately. In the rough method the rule is taken in one hand and stepped along the surface to be measured, say a board, the termination of the rule on the board being judged at each step by the eye, or marked by a rub with the brass end of the rule. Fig. 10 shows the more accurate method, the length of the rule being ticked off on the surface of the board and the process repeated until the end of the board is reached.

The thickness of a board is measured as in Fig. 12. This method is better than using the end of the rule, as the corners get worn. The rule shown in Fig. 5 is also useful for getting the thickness of

the boards, the method of using it being obvious. The slide rule in Fig. 7 is useful for obtaining the depth of grooves, etc.

Fig. 13 shows a simple method of dividing the width of a board into two or more equal parts. Suppose a board 7 in. wide is to be sawn into three strips. Lay the rule in a slanting direction across the board and so that, say, figures 2 and 11 coincide with the edges of the board. Mark the board at figures 5 and 8; the board will thus be divided equally into three parts. Lines parallel to the edges are then drawn as shown in Fig. 14.

Other methods of measuring and drawing parallel lines will be given later.

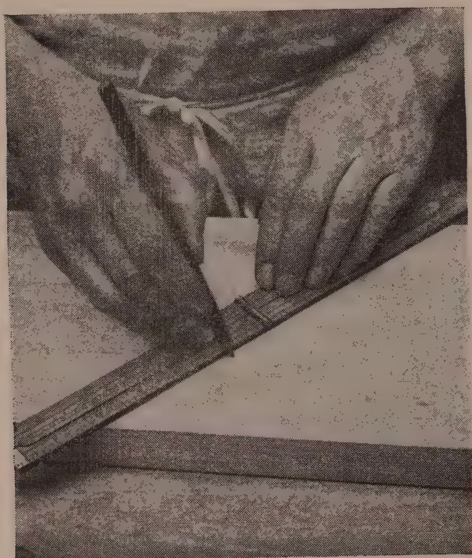


Fig. 13.—Dividing Board into Three Widths

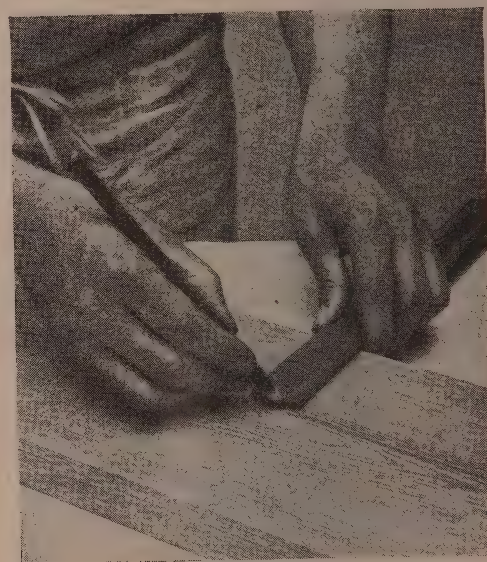


Fig. 14.—Lining-down with Rule and Pencil

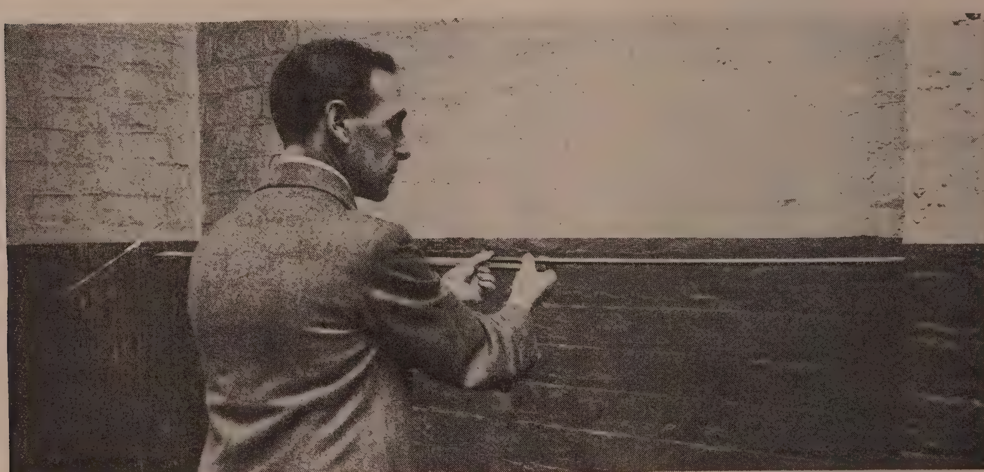


Fig. 15.—Taking Width of Recess with Pinch-rod—Two Laths, one sliding on the other

STRAIGHTEDGES

Straightedges are used in woodworking for testing and marking. They are of various sizes, a useful size for small jobs being about 3 ft. long, $2\frac{1}{2}$ in. wide, and $\frac{1}{4}$ in. thick. Fig. 17 shows a typical example.

A straightedge may be tested for accuracy in three ways: (1) Hold another straightedge against it. (2) Place the straightedge on a flat surface and draw a line (see Fig. 18); turn the straightedge over and compare the edge with the line, then, if they coincide, the straightedge is accurate. (3) Spy down the edge of the straightedge (Fig. 16). Note that a good straightedge should be straight "both" ways: (*a*) the flat surface should be straight and (*b*) the edge should be straight.

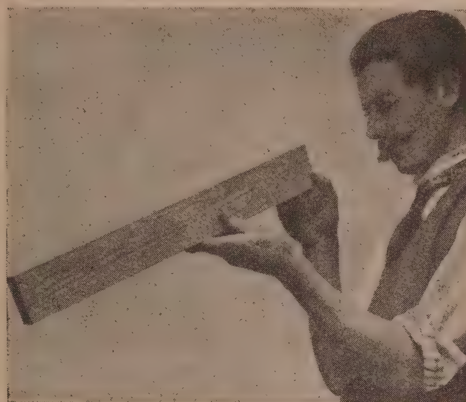


Fig. 16.—Sighting Straightedge for Accuracy

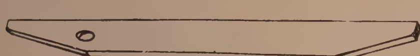


Fig. 17.—Straightedge

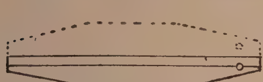


Fig. 18.—Testing Straightedge Geometrically

PENCILS

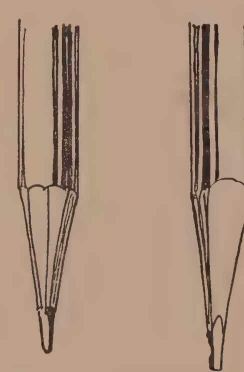
Any ordinary pencil is suitable for woodwork. "Carpenters' pencils," which were largely used a few years ago, are oval in section and last longer than the ordinary type, but they are clumsy and do not assist accurate work.

Pencils are made in various degrees of hardness and those by good makers have the degree of hardness printed on them. The degrees vary in good makes from 6B to 6H—the more B's there are the softer the pencil and the more H's the harder. The degrees are thus:—BB, B, HB, H, HH—Of late years a new degree F has been manufactured and is between HB and H. For general work F is the best—H being a little too hard and HB a little too soft. Of course any one of these three degrees is near enough for ordinary use.

Fig. 19 shows the ordinary method of sharpening the pencil, the length of the point being about an inch; if too long, the lead is apt to break and if too short or dumpy inaccurate work is likely to result. A chisel is more useful than a pocket-knife for sharpening pencils.

Sometimes the pencil is sharpened to a chisel point as Fig. 20; this will last longer and give fine lines, but is not so convenient to use, and cannot be conveniently used for writing.

Fig. 21.—Reel for Chalk Line



Figs. 19 and 20.—Shapes of Pencil Points

CHALK LINES

A chalk line is sometimes found very useful for marking long lengths. A cotton line is the best as it holds the

chalk-dust better. A reel, as shown in Fig. 21, is often used to hold the line.

The line is chalked by fastening one end (or getting someone to hold it) and rubbing the line with a piece of chalk. To use the line (*see* Fig. 22) fasten one end at the correct point and pull the other end until the line is taut; then, as near the middle of the line as possible, pull the line a few inches away from the surface and let it go. A straight chalk line will thus be flicked on the surface. For use on white wood, a "chalk line" may be charged with black lead.

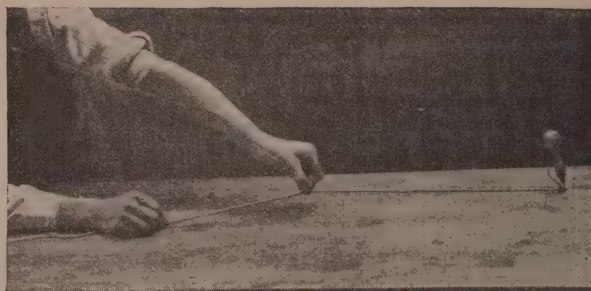


Fig. 22.—Chalk Line in Use

In Fig. 22 a short line is shown being marked in order to illustrate the method clearly.

PINCH ROD

Fig. 15 shows the method of obtaining the width of an opening by using a "pinch rod." The latter consists of two laths (or rules) which are held so that they touch each side of the opening and are then gripped together.

MARKING KNIVES AND AWLS

For bench work, and any work demanding accuracy, a marking knife is preferable to a pencil. Fig. 23 shows a usual type, one end being chisel shaped and the other pointed, the latter for ordinary marking, and the former for cutting into the surface of the wood a little, as in tenoning and dovetailing. Fig. 24 shows a marking knife with a handle which can be gripped better and is more convenient to use, while Fig. 25 shows a handled marking awl.

Fig. 23 represents the type in general use and is good enough for all practical purposes.

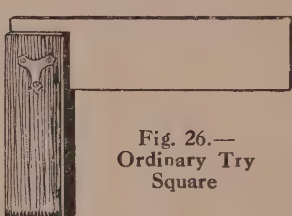


Fig. 26.—Ordinary Try Square

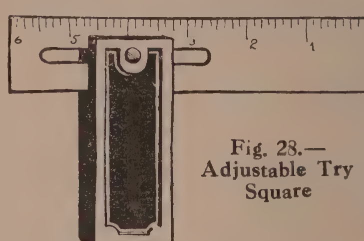


Fig. 28.—Adjustable Try Square

Fig. 23.—Marking Knife and Awl

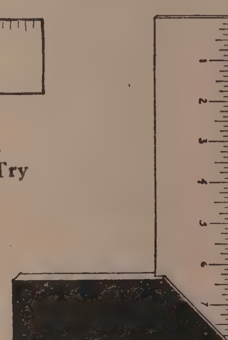


Fig. 27.—Combined Square, Mitre Square and Rule

Fig. 24.—Handled Marking Knife

Fig. 25.—Handled Marking Awl

SQUARES

The most commonly used square in woodworking is the type shown in Fig. 26

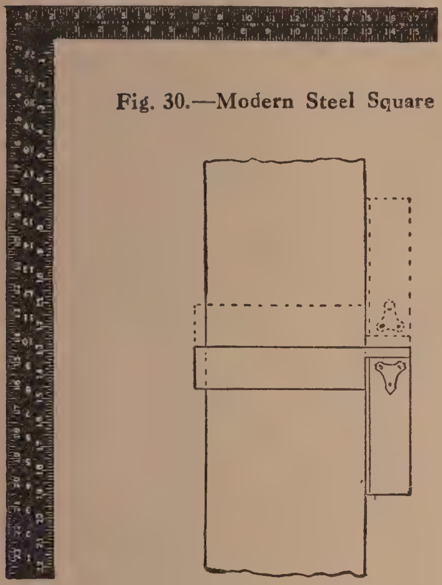


Fig. 30.—Modern Steel Square

Fig. 29.—Testing Try Square

with the blade 6 in. long, the blade being of steel and the stock usually of ebony lined with brass on the inside face to prevent wearing. This square is made in various sizes, the 12 in. being largely used.

Fig. 27 shows a mitre square and rule combined; this square can be used for lines at 90° or 45°. An adjustable try square is shown in Fig. 28.

Steel squares (Fig. 30) are nowadays used largely by woodworkers, but chiefly on roof work and to a lesser degree in staircasing. Fig. 31 shows how this square is used for getting the length of a rafter when the span and rise are given. In the illustration the span would be 16 ft. and the rise 6 ft., and the length of the rafter the distance between the points on the legs of the square, or 10 ft. If a fence were now screwed on the square lineable with A C, the square would be suitable for marking the top and bottom bevels for the rafters (*see* Fig. 33 and 34).

Ellis's patent steel square (Fig. 32) has a metal adjustable fence and other improvements.

Crenelated squares are useful for setting-out work, particularly carpentry. They have a series of notches in the blade, as illustrated clearly in Fig. 35. A pencil or marker is placed in a crenelation (or notch) and the square glided along the timber, thus making a mark parallel to the edge of the timber.

Wooden squares of a larger size than the metal type are often very useful for squaring frames, etc. A handy size for a square of this type is with the blade about 2 ft. long. The illustration (Fig. 36) shows the square with blade and stock pulled apart to show the joint. They are usually made of baywood (mahogany).

A square may be tested for accuracy as in Fig. 29. Select a board having a straight edge and, holding the stock firmly

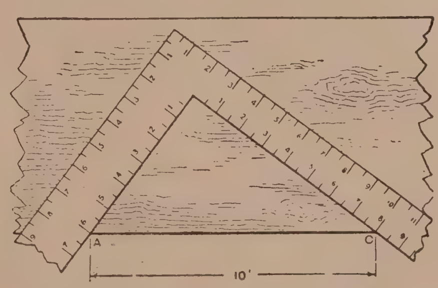


Fig. 31.—Obtaining Length of Rafter with Steel Square

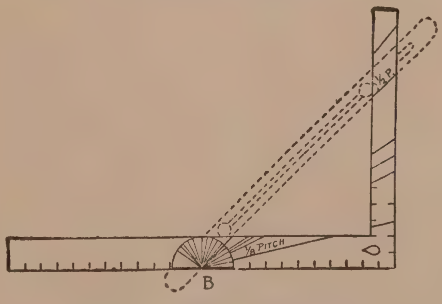


Fig. 32.—Ellis Steel Square

against the edge of the board, draw a line across the board; turn the square over and if the edge of the square coincides with this line then the square is

accurate. If not, draw another line, and the amount of inaccuracy will be half the angle between the two lines. In the case of a wooden square that has been accidentally knocked inaccurate, the top edge of the blade may be "shot" with the trying-plane until correct, when, of course, the under edge must not be used because that will remain out of square. When a metal square gets out of truth (with dropping on the ground usually) the best remedy is to buy a new one.

Fig. 33.—Adjusting Gauge of Steel Square

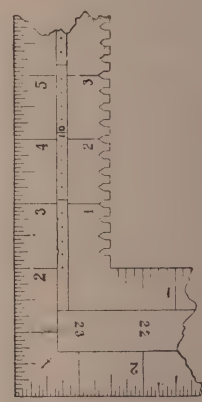


Fig. 35.—Crenelated Steel Square

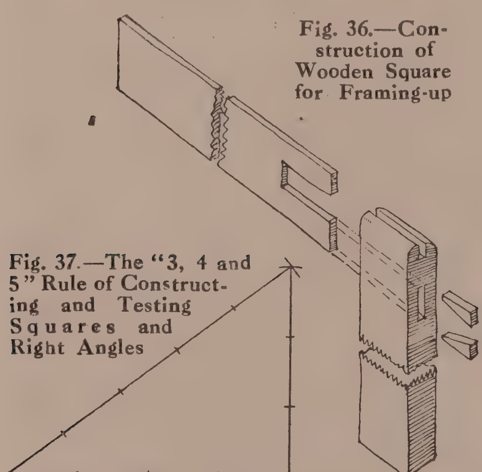


Fig. 36.—Construction of Wooden Square for Framing-up

Fig. 37.—The "3, 4 and 5" Rule of Constructing and Testing Squares and Right Angles

Fig. 34.—Marking Rafter Bevels with Steel Square

Another method of testing squares

or of drawing square angles, is by means of the "3, 4 and 5 rule" (Fig. 37). Set off four units (inches, feet, or any other unit) along the line; strike off three units from one end to intersect five units set off from the other end. A triangle is thus obtained with sides in the proportion of 3 : 4 : 5. This must be a right-angled triangle because "the squares of two sides of a right-angle triangle must be equal to the square of the hypotenuse," that is, $3^2 + 4^2 = 5^2$. This rule is very useful for large angles.

Figs. 38 and 39 show the method of using the square for marking lines on timber. The chief point to be watched is that the stock of the try-square should be kept tightly against the edge of the timber.

In testing a piece of timber for squareness the try-square is held as Fig. 41.

Fig. 38.—First Position in Using Try Square

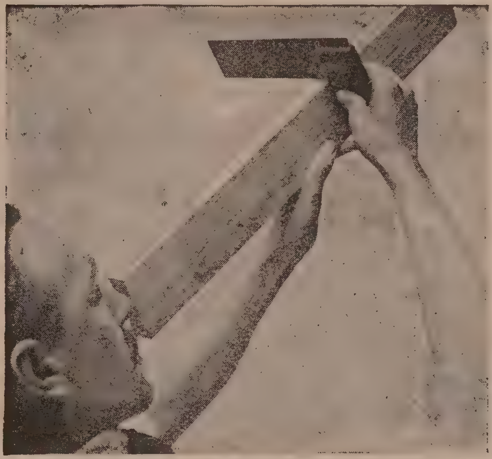


Fig. 40.—Testing Square Edges with Try Square

Fig. 39.—Second Position in Using Try Square

Fig. 41.—Using Adjustable Bevel

Keep the stock tightly against the flat side of the timber—do not use the stock against the edge. Hold the timber towards the light, as shown, for small work; in this way the smallest inaccuracy can be seen. When testing large pieces of timber one end can be rested on the bench. Apply the square at intervals of about 1 foot, or glide the square along the timber.

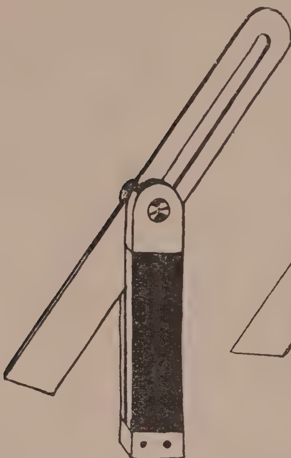


Fig. 42.—Ordinary Adjustable Bevel

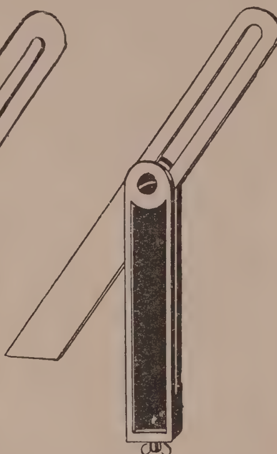


Fig. 43.—Bevel with Double-wing Nut

Fig. 45.—Using Square Template on Glazing Bar when Use of Try Square is Inconvenient

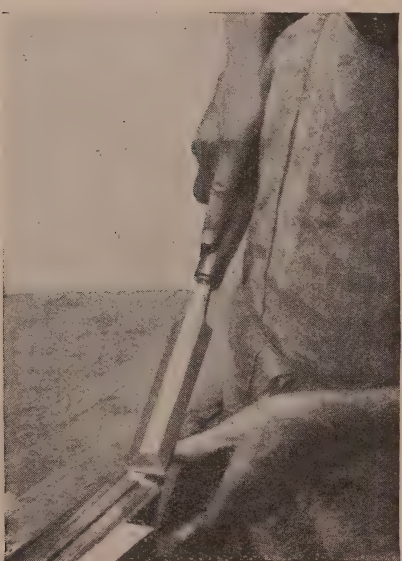


Fig. 47.—Using Mitre Template in Paring a Mitre

Fig. 46.—Mitre Template

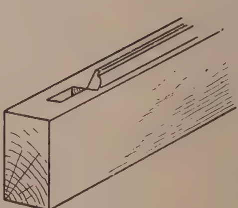


Fig. 48.—Mitre in Joint-making for which Mitre Template is used

Fig. 44.—Bevel with Single-wing Nut for Tightening

BEVELS

Bevels are necessary for marking and testing angles that are not right angles.

The ordinary type of bevel is shown in Fig. 42, the blade being slotted so that its length can be adjusted for various purposes and also so that the blade will shut into the stock when not in use.

The blade is secured in the required position by tightening the screw with a screwdriver. The method of adjusting the bevel is first to set it to the correct angle; then tighten the screw and compare with the desired angle. It will usually be found that the bevel has altered a little in screwing up. The blade should therefore be tapped gently on the bench and the bevel again compared with the angle desired. When correct the bevel is screwed up tightly. Fig. 43 shows a wing nut for tightening up, a screwdriver being dispensed with. Fig. 44 shows a bevel with a tightening screw at the end of the stock.

For rough work a bevel may be dispensed with and the rule used instead; the rule is very handy and quickly set, but is easily knocked out of the correct angle and is therefore unsuitable where accuracy is required.

Fig. 49.—Ordinary Marking Gauge

Fig. 50.—Marking Gauge with Rule Stem

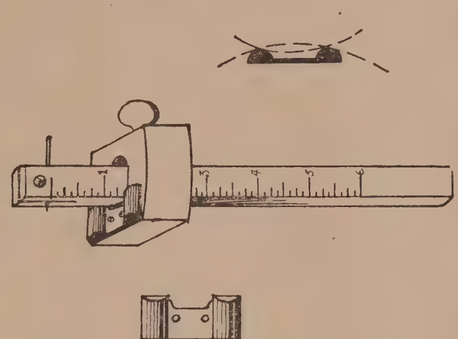


Fig. 51.—Marking Gauge for Curved Work

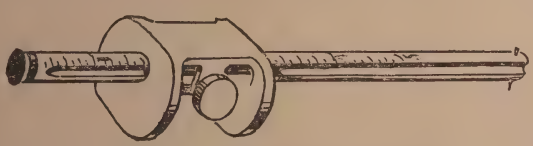


Fig. 52.—Metal Marking Gauge

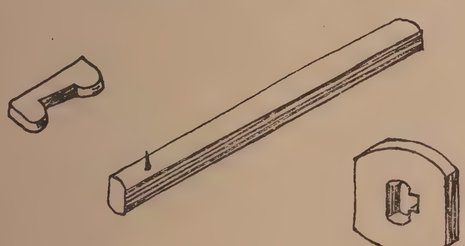


Fig. 53.—Home-made Marking Gauge with Wedge Fastening

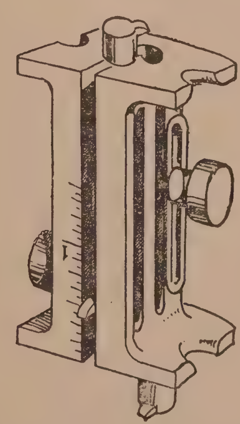


Fig. 54.—Stanley Butt Gauge

TEMPLATES

A template in woodworking can mean either a pattern (say, of thin wood or

paper) or a tool-guiding appliance used in marking or cutting angles. The latter kind of template includes the "mitre template" and the "square template."

Fig. 46 shows the ordinary brass mitre template which is used for mitreing and scribing joints, while Fig. 47 shows it in use. Care should be taken not to chisel too much off the joint—beginners have a tendency to do this. Take a little off at a time and gently tap the template backwards. But even at the finish leave the joint a little full here because this is the most noticeable part of the joint and it will easily crush up a little. Remember you can always take a little more off but you cannot put a little more on. Fig. 48 shows part of a mitred-and-tenoned joint showing where the end of the moulding has been cut with the aid of the mitre template.

Templates are also made in wood, but brass is better, as the chisel is bound to slip a little into the wood template occasionally, and thus destroy its accuracy.

Square templates are chiefly used for marking as in the case of window bars or other pieces of wood where it is awkward to use a square. It is a useful tool for joiners, but it is not essential for most woodworkers. Fig. 45 shows the square template being used to square a line round a moulded sash bar.

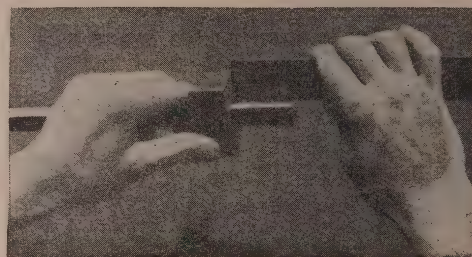
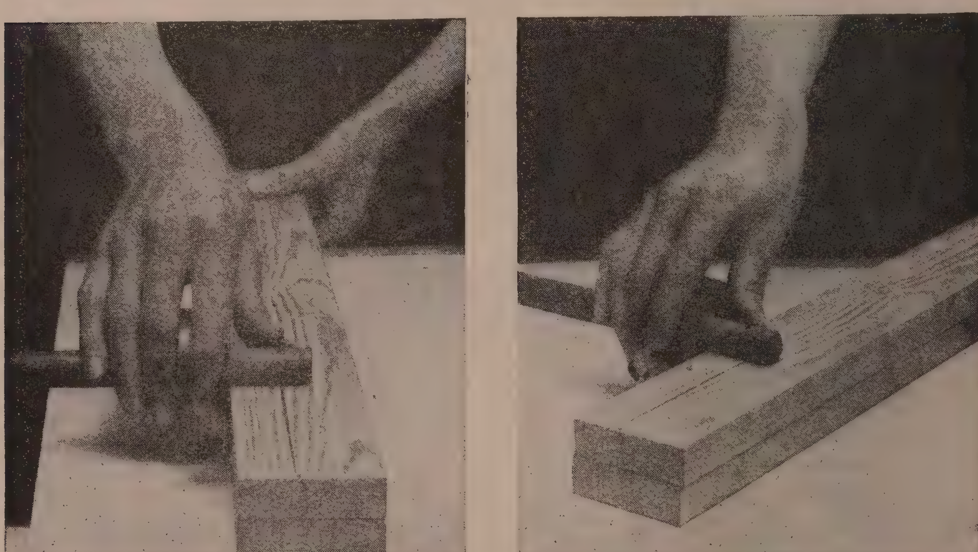


Fig. 55.—Setting Marking Gauge

Templates are used for dovetailing, etc., and mitre blocks and boxes are also forms of mitre templates; all these will be dealt with in later chapters.

GAUGES

Marking Gauges.—Gauges are used for marking parallel lines. The simplest type is the marking gauge, varieties of which are shown in Figs. 49 to 54. The ordinary workshop type (Fig. 49) consists



Figs. 56 and 57.—Holding and Using Marking Gauge: Note Disposition of Fingers

of four parts: stem, head, fastening screw, and marker. The stem and head are usually of beech and the screw of boxwood. Various methods of fastening the head to the stem are in use (see Fig. 53 for another method) but the screw is the best. The marker is simply a pointed bit of steel.

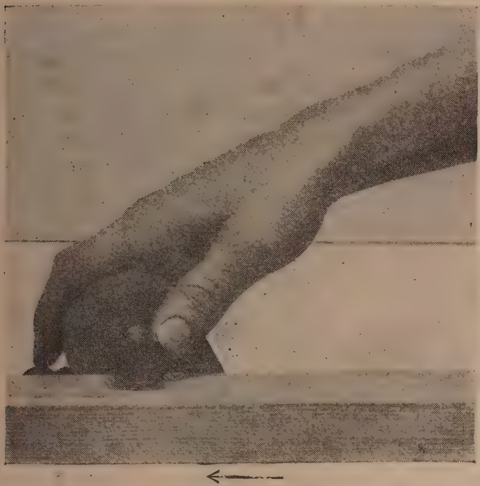


Fig. 58.—First Position of Marking Gauge: Arrow shows Direction of Stroke

In setting the gauge it is taken in the left hand (Fig. 55), the screw loosened, and the head adjusted to the correct distance from the point by using the rule as shown. After the screw is tightened the gauge should again be tested; it will probably have moved a little in tightening, when, if so, the head can be shifted a slight amount by tapping the end of the stem on the bench.

It is very often desired to gauge a line down the centre of a board. The obvious method is to measure the board, divide by two, and set the gauge; this takes too long and is not so accurate as from the description it would seem to be. Instead, guess half the width of the board, set the gauge accordingly and mark the distance from each side; two points near the centre of the board will thus be obtained and the gauge is then set accurately mid-way between them.

The method of holding the gauge is shown in Figs. 56 and 57. Hold it in the right hand with the thumb near the top of the stem, the first finger on the head, and the rest of the fingers on the stem. The chief thing to bear in mind is that the head of the gauge must be pressed continually against the edge of the timber from which you are gauging. Do not let the marker dig deeply into the wood; this is avoided by giving the gauge a slight rotary movement as shown in Figs. 58 and 59. At the beginning of the stroke the stem should be touching the wood at its far corner; as the gauge is pushed forward the point should be gradually pressed down into the wood, as shown in Fig. 59.

Fig. 50 shows a gauge with a scale on the stem. This is occasionally an advantage, but for good work simply setting the head to this scale is not accurate enough.

Fig. 51 shows a gauge with a metal plate attached to the face of the head; this enables the gauge to be used for either concave or convex work, as shown in the small sketch. Note also that this gauge has a small screw in the stem for adjusting the marking point.

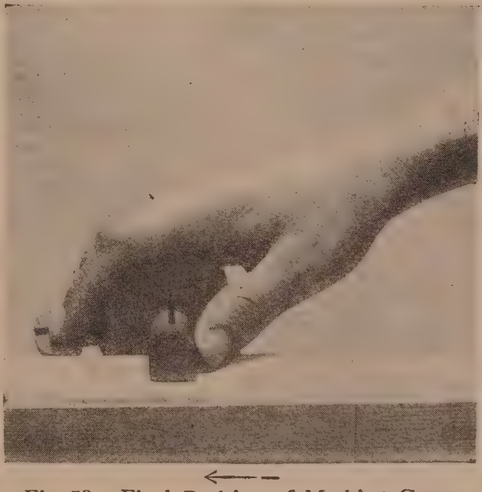


Fig. 59.—Final Position of Marking Gauge

A metal marking gauge is shown in Fig. 52; this has a point marker at one end and a roller marker at the other.

The latter makes a fine mark, and is useful across the grain and in knotty timber.

A home-made gauge is shown in Fig. 53, and in this a wedge is used for fastening, the wedge being made of such shape and size that it cannot fall out when the gauge is put together.

The "Stanley Butt Gauge" shown in Fig. 54 is a special type used chiefly in America for fitting butt hinges. The gauge has two bars; one bar has two points on it, one for gauging the edge of the door and the other for gauging the door casing, in which second case the end of the gauge head is used as a guide. The marking point on the other bar is used for gauging the thickness of the hinge. This gauge may be carried conveniently in the pocket.

Cutting Gauges.—This type of gauge (Fig. 62) is similar to a marking gauge except that it has a cutter instead of a marker. It is especially suitable for dovetailing, where it is an advantage to cut into the wood a little. Thin wood may be cut into strips, or small rebates may be made with a cutting gauge in first-class condition. The cutter is usually held in the stem by a small wedge.

Fig. 61 shows a combined marking, cutting, and pencil gauge. The last named is very useful for chamfering, because if an ordinary marking gauge were used the marks would be left on the timber after the chamfers were made.

Mortise Gauges.—A mortise gauge (Fig. 63) is similar to a marking gauge, but it has two points for marking two lines simultaneously. This, of course, saves much time when marking mortise and tenon joints. One point is attached to the stem as in a marking gauge and the other point is attached to a slide that works in the stem, and is adjusted by a screw at the bottom of the stem. Either a thumb screw or a flush screw is used, it being preferable to have the screw flush with the bottom of the stem (Fig. 63), as a projecting screw is liable to get out of order. Fig. 66 shows an inferior type of mortise gauge in which the slide is actuated by simply pulling or pushing it to the desired position; this is more difficult to set accurately than the preceding types.

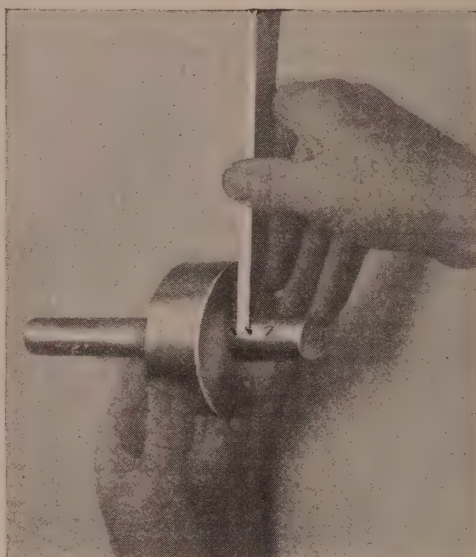


Fig. 60.—Setting Mortise Gauge to Width of Chisel

Fig. 60 shows how the mortise gauge is held when setting for mortising. The two points are adjusted to the correct distance apart by holding the mortising chisel against them. The head is then screwed up at the correct distance from them. In marking a mortise in the centre of a piece of timber the points should be set to the width of the chisel, the head "loosely tightened" as near the required position as can be guessed, and the points pricked into the timber from each side. Finally the gauge is adjusted by tapping slightly on the bench, and the screw in the head is then tightened up.

COMPASSES, DIVIDERS AND TRAMMELS

Compasses and Dividers.—The "compasses" used in woodworking are really dividers. Fig. 67 shows the usual shape and Fig. 68 illustrates a pattern with sensitive adjustment.

Fig. 61.—Combined Marking and Cutting Gauge

Fig. 62.—Ordinary Cutting Gauge

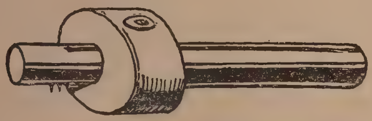


Fig. 63.—An Ordinary Type of Mortise Gauge: Flush Screw at End of Stem

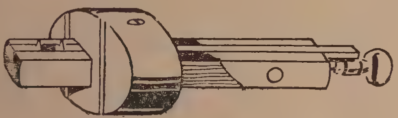


Fig. 64.—Mortise Gauge with Projecting Wing Nut

Fig. 65.—Square-stock Mortise Gauge with Projecting Screw

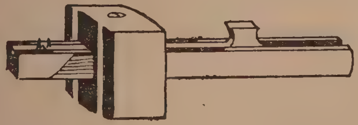


Fig. 66.—Mortise Gauge without Fine Adjustment

Fig. 67.—Wing Compasses

Fig. 68.—Wing Compasses with Sensitive Adjustment

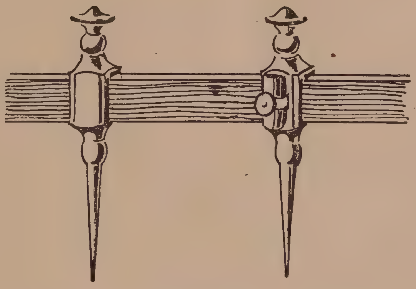


Fig. 69.—Trammel Points attached to Lath

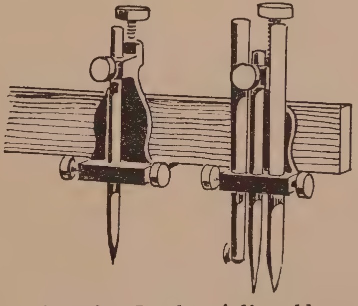


Fig. 70.—Stanley Adjustable Trammel Points

Compasses are used for drawing circles and other geometrical work, but the most common use to which they are put in practical work is scribing. Fig. 71 shows a piece of skirting that has to be fitted to an uneven floor. The skirting board is loosely nailed into position (or otherwise temporarily held) and the compasses set to the greatest width of the gap between the floor and the board. The compasses are then drawn along with one point on the floor while the other marks the board. In order to keep the vertical scribing distance constant, it is better to rest the wing on the floor when using; if this is done and the compasses kept vertical a mark will be made on the board at a constant distance from the floor. The skirting is then chopped or planed to this line, when it will be found to fit the uneven surface of the floor accurately.

Fig. 71.—Scribing Skirting Board to Floor

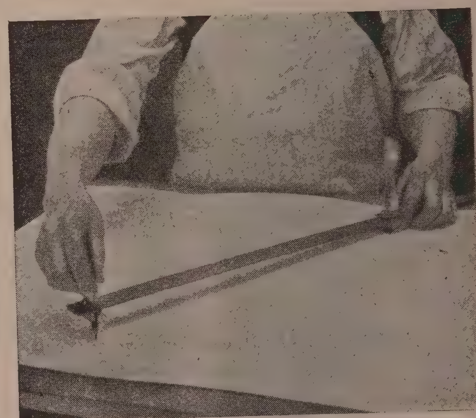


Fig. 74.—Wait's Attachments Forming a Trammel

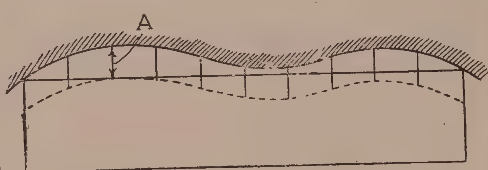


Fig. 72.—Scribing by the Spiling Method

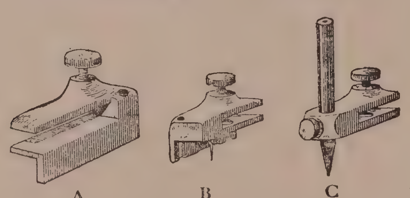


Fig. 73.—Wait's Rule Attachments

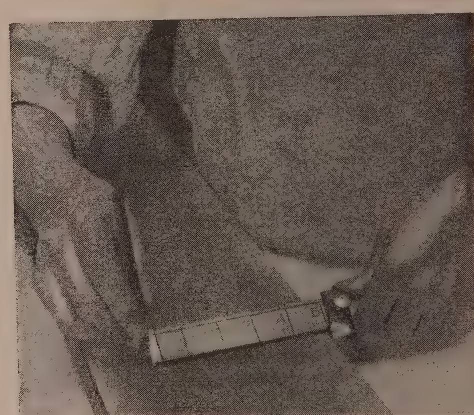


Fig. 75.—Wait's Attachment in Use for Lining-up a Board (attachment should be in close contact with edge of board)

This method of scribing is used in numerous cases where linings, framings, plinths, etc., have to be fitted to uneven surfaces. Care should always be taken that the compasses should be set and held

in the precise direction that the board has to be moved up to fit into its final position; this is more clear in Fig. 72. Sometimes the compasses are dispensed with and parallel lines are drawn; along each of these parallel lines the scribing distance A (Fig. 72) is set. A freehand line through the points thus obtained will show the wood that must be removed. This method is sometimes called "spiling," a small strip of wood the length of A being used.

Trammel points are used for drawing large circles. A pair of these are shown in Fig. 69; they need only be screwed to a strip of wood at the correct distance apart. Fig. 70 shows a pair of Stanley trammel points; both points are adjustable for height, and one end has a pencil and a roller marker as well as a trammel point. A trammel for drawing ellipses will be dealt with later.


Fig. 76.—Ordinary Spirit Level

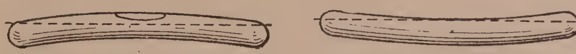


Fig. 78.—Spirit-level Tubes: Correct and Incorrect Settings


Fig. 77.—Spirit Level with Side Openings

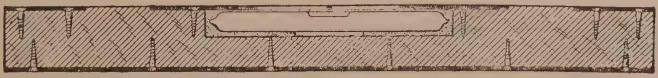


Fig. 79.—Section through Spirit Level

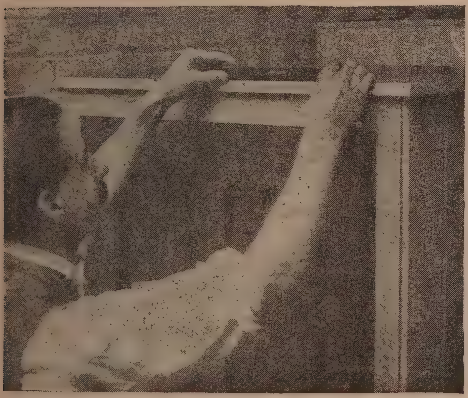


Fig. 80.—Using Spirit Level with Side Openings above Operator's Head

Wait's rule attachments (Fig. 73) are useful for drawing circles and parallel lines. Fig. 73 (A) is for use on a rule as a gauge; it is shown in use at Fig. 75. (B) Fig. 73 is attached to the rule and forms a centre point; (C) Fig. 73 is to hold a pencil. The last two attachments are shown in use in Fig. 74; a bradawl often replaces the small point shown at B (Fig. 73).

SPIRIT LEVELS, PLUMBS, ETC.

Spirit Levels are used for testing horizontals. When purchasing a spirit level avoid getting a fancy or flimsy article. The chief points of a good level are: (a) it should be as long as possible without being inconvenient; (b) it should be strongly made; (c) it should have a quick bubble. The reasons for these three points should be obvious; the longer the level the more accurate the work; it should be strongly made to withstand occasional knocks—a metal plate along the bottom is an advantage; a slow bubble is not as accurate and takes longer to use than a quick bubble.

Fig. 76 shows a cheap level; its chief fault is that it has no openings in the side so that the bubble can be seen when the level is held high up. This seems a slight matter, but in practice it is a great inconvenience not to be able to use the level at the height of the eyes or even above the head. Fig. 77 shows a better type with side openings.

A section of the level showing the tube in position is shown in Fig. 79. The tube is of glass and is nearly filled with methylated spirits. The bubble is the amount the tube is *short of being full;*

this means that when the tube is tilted the spirit runs to the bottom and the *bubble runs to the top*. Beginners have difficulty in accounting for the latter phenomenon, but if it is not understood a level cannot be used quickly and satisfactorily.

Sometimes the tube gets broken, but it can easily be replaced with a little care. Tubes (Fig. 78) can be bought separately from local dealers.

In fixing a new tube proceed as follows: Set a piece of smooth wood level on the bench or in the vice, testing it by means of a level of proved accuracy. Unscrew the plate off the top of the level to be repaired and scrape away the plaster-of-paris in which the broken tube was embedded. Mix some fresh plaster-of-paris with water and put a little in the groove (chiefly at the ends) that holds the tube. Press the tube gently into the plaster until the bubble comes to rest exactly in the centre. Note that the tube is slightly curved in length, and take care to fix it with the round or convex side upwards. When the tube seems to be correctly placed, mark round the level with a pencil on to the board; reverse the position of the level, keeping to the pencil lines. Place the top plate in position and see whether the bubble is correct with it. If everything is all right let the plaster set a minute or two and then screw the top plate down.

In using the level greater accuracy is obtained if it is used on the top of a parallel straightedge, particularly if the surface to be levelled is rough or not straight.

The Stanley Company manufactures numerous patterns of spirit levels; for

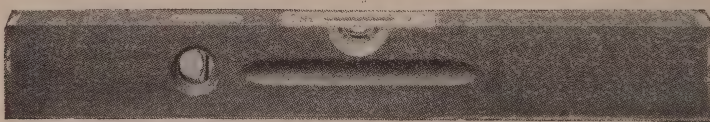


Fig. 81.—Stanley Combined Spirit Level and Plumb Rule

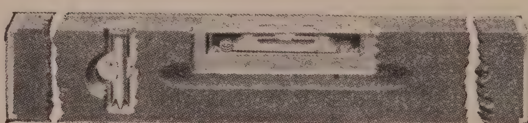


Fig. 82.—Broken View of Combined Level and Plumb Rule

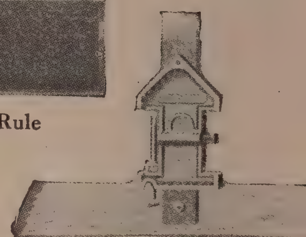


Fig. 86.—Stanley "Odd Jobs," combining Level, Rule, Plumb, etc.

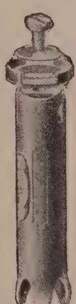


Fig. 83.—Plumb-rule Tube (*see also* Fig. 82)

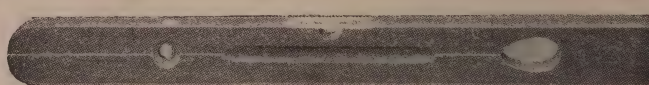


Fig. 84.—Spirit Level and Plumb Level, with Hole for Plumb Bob

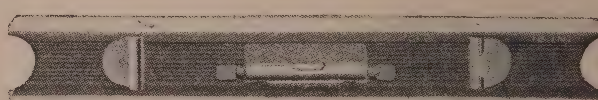


Fig. 85.—Metal Combined Plumb Rule and Level

example, Fig. 81 shows a combined spirit level and plumb rule, the small vertical tube being used for "plumbing" vertical work. Fig. 82 is a broken view of this rule showing how the levels are fixed in position. Both level and plumb tubes are made so that they can be adjusted; notice the small springs under the level tube, which can be screwed down at each end and any slight inaccuracy that arises in the level thus corrected. The vertical tube (shown enlarged in Fig. 83) is adjusted by means of the set-screw and the slotted cup. Notice the slight convex curve on the tube glass.

Fig. 87.—Plumb Rule

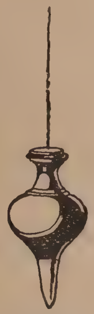


Fig. 88.—Screw Plumb Bob

A level with plumb level and hole for a plumb bob is shown by Fig. 84, and a metal combined plumb rule and level by Fig. 85. Stanley fittings for use with levels include level sights for levelling at a distance and pitch adjusters for setting surfaces to any desired inclination. The Stanley "Odd Jobs" tool No. 1, illustrated in Fig. 86, combines level, rule, plumb, gauge, etc.

A Plumb Rule and Bob can easily be made. Fig. 87 shows a common design. A convenient size is 3 ft. 6 in. by 3 in. by $\frac{5}{8}$ in. Three saw cuts are made in the top for fastening the string. Lines are gauged down the centre of the rule and a hole formed near the bottom for the bob to swing into. A bob may be made by casting one in a sand mould and then boring a fine hole through it for the string. Turned lead bobs can be bought. Fig. 88 shows an iron or brass bob with the top to screw off so that the string can be threaded through it and the top screwed on again. They are neater in appearance than lead bobs.

"Plumb up" means vertical or pointing to the centre of the earth; "level" means tangential to the earth's surface, and therefore, at any point, a plumb line is at right angles to a level line.

In a later chapter detailed instructions on making a spirit level will be given.

Saws and Sawing

The Cross-cut Saw.—Hand saws may be divided into two classes, cross-cut saws and rip saws. As the names imply, the cross-cut saw is for cutting across, and the rip saw for cutting or ripping, with or along, the grain.

A cross-cut saw is shown in Fig. 1. The blade is of steel and varies in thickness, diminishing towards the end and the back, while the usual length is 26 in. A tapered blade is lighter, easier to handle, and clears itself in the saw kerf. The thickness varies, as shown by the numbers in Fig. 3, the smaller the number the thicker being the blade at that part; "E" means easy or bare and "T" tight or full.

Usually the back of the saw is straight (*see* Fig. 2), but the skew-back shape as in Fig. 1 is very common.

The shape of the teeth is shown at Figs. 7 to 9. Such a tooth-shape has been found to be of the best proportions for biting into the wood and yet sawing smoothly. The shape shown in Fig. 5 would cause the saw to stick and jump, and would make the sawing difficult and dangerous. On the other hand, the shape shown in Fig. 6 would not bite enough. Fig. 4 shows a mean between the two.

If the saw simply consisted of a blade with teeth stamped out as shown in Fig. 7 the saw could hardly be used at all, because (*a*) the "point" of each tooth would be an *edge* and therefore would not cut the fibres easily, and (*b*) the saw "kerf" (the cut made by the saw) would be so narrow that the saw blade would "bind" or rub on its sides.

If the teeth are filed on the slope they will appear as in Fig. 8. *Points* are thus formed on the teeth instead of *edges*, thus enabling the saw to cut better. If, next, the teeth are pressed alternately to one side and then to the other, as in the plan Fig. 9, the teeth will be wider at the cutting points than the thickness of the saw. A wide saw kerf will thus be made, through which the saw blade can pass easily to and fro. This bending of the teeth is known as "setting" the saw.

If any hard metal point (a nail) is dragged across a piece of timber a scratch results. Each tooth of a saw is like a sharp nail; *see* Fig. 12, which shows a piece of wood with a row of nails knocked into it and bent alternately to each side to demonstrate the "set" of a saw. It is obvious that if the nail points are sharp and if this instrument is dragged backwards and forwards across a piece of wood it will ultimately make a groove, or possibly cut the timber in two. In some such way the saw acts. Fig. 13 is an enlarged section of the saw kerf showing how the points of the teeth scratch their way through the wood while the other parts of the teeth remove the centre portion of the kerf. The amount of "set" on the saw determines the amount of clearance. More set is required for soft woods than for hard woods, and more for wet woods than for dry woods. A saw for use on wet soft wood should therefore have considerable set.

Cross-cut hand-saw teeth are usually about six to the inch. The hardened and tempered steel blade of the saw should admit of being bent so that the tail nearly touches the handle, and of springing back straight so that there is no buckle in the saw. Any buckling of the blade may be easily seen by looking along the edge of the teeth.

The saw handle should be of a good shape for gripping firmly and easily, and should be attached to the blade by saw screws. If the blade ever becomes loose these screws should be tightened up with a brace and a forked bit (*see* Fig. 38 on a later page).

Using Cross-cut Saws.—The most difficult part in sawing is starting the saw. Guide the saw by putting the thumb against it as in Figs. 10 and 11. Take two or three up strokes to get a start. If you try to start by a down stroke there will be a danger of the saw jumping and damaging the work or cutting your finger. This method of starting the saw is applicable to all varieties of saws. Some workers guide the saw with the knuckle instead of the thumb.

Fig. 1.—Skew-back Hand Saw

Fig. 4.—Good Tooth Shape; mean between Figs. 5 and 6

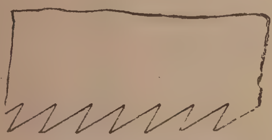


Fig. 5.—Impracticable Shape of Teeth

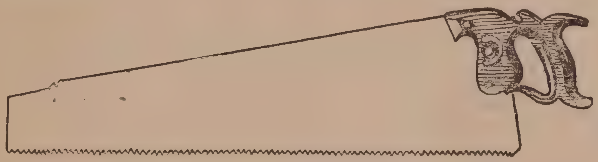


Fig. 2.—St.aight-back Hand Saw

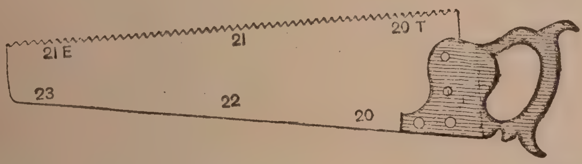


Fig. 3.—Saw with Numbers indicating varying Thickness of Blade

Fig. 6.—Dull-cutting Teeth

Beware of two mistakes in sawing: (*a*) using short strokes, (*b*) pressing on the saw. Use as long strokes as possible; do not saw too quickly; do not press on the saw, but rather let it work by its own weight. If the saw is forced, it will require harder work and will be more difficult to guide. Simply pull the saw slowly backwards and push it slowly forwards in long strokes. This is the easiest method, and the safer, more accurate, and quicker in the long run.

Fig. 15 shows the method of sawing the end off a board—the latter resting on sawing stools, etc. The waste piece of board is supported by the left hand to prevent it from splitting a piece off the board. As the board is being cut this "short end" should be held in such a way that the kerf is widened, thus assisting the saw and preventing it from binding.

Sometimes a long board has to be cross

Fig. 7.—Teeth Stamped Out Square

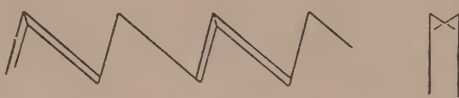


Fig. 8.—Teeth Filed

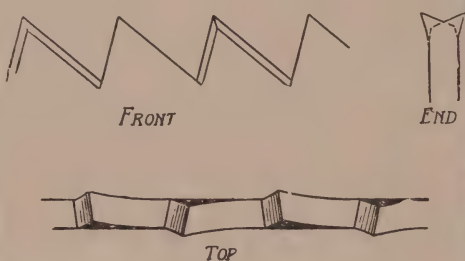


Fig. 9.—Teeth Filed and Set

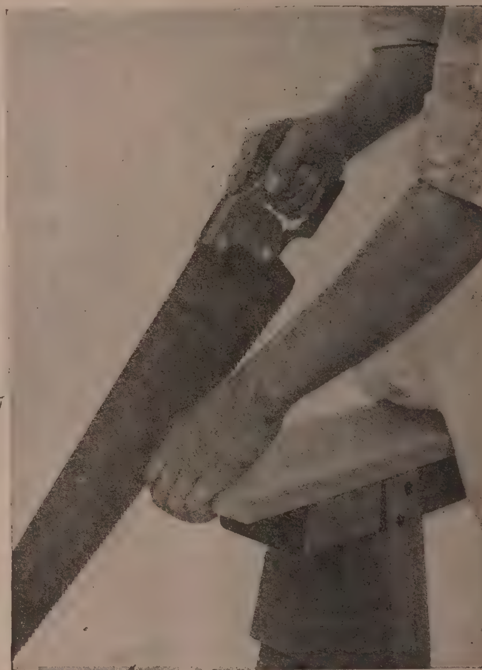


Fig. 10.—Guiding Saw with Knuckle for Cross-cutting or Ripping

Fig. 11.—Guiding Saw with Thumb for Cross-cutting or Ripping

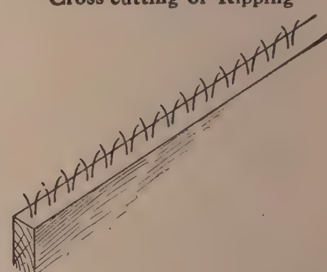


Fig. 12.—Row of Nails to Show Action of Saw Teeth

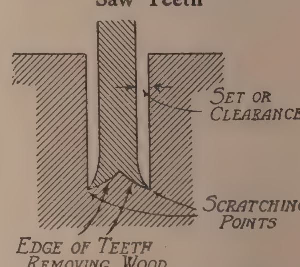


Fig. 13.—Saw Kerf, showing Action of Teeth

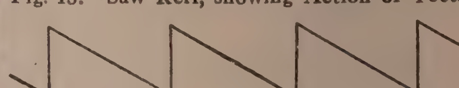


Fig. 14.—Rip-saw Teeth

Fig. 15.—Method of Sawing End off Board to Prevent Splitting

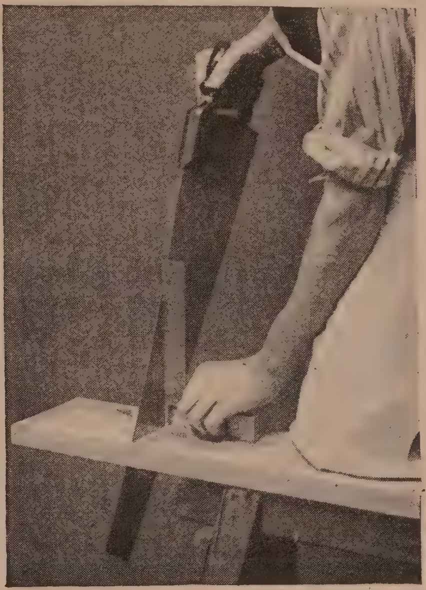


Fig. 16.—Testing Squareness of Cutting

Fig 17 —Cross-cutting Long Board near Middle

Fig. 18. Sawing End off Long Board : Only one Trestle available

cut in the middle (Fig. 17). In this case it is better if someone holds the work at one side of the saw. Notice that if the assistant drops the board slightly or lets it move towards the worker, the saw kerf will partly close and the saw will bind.

Fig. 18 shows the method of sawing the end off a long board when only one sawing stool is available.

The Rip Saw.—This saw is for cutting in the direction of the grain. Of course, a cross-cut saw can do this, but a rip saw does it more rapidly, as the teeth are especially designed for cutting with the grain. The shape of the teeth is shown in Fig. 14, the front of the tooth being vertical. There are usually four teeth to the inch, and the length (28 in.) is greater than that of the cross-cut. Otherwise the general appearance of the two is much the same.

Owing to the use of machinery, rip saws are now little used and the average craftsman does not possess one, the cross-cut being employed for all kinds of rough sawing.

Using Rip Saw.—Three methods of using the rip saw are shown in Figs. 23 25 and 26. Fig. 23 shows the usual method; follow the same instructions as for cross-cutting. Fig. 25 shows a method of rip sawing favoured by cabinet-makers chiefly. Fig. 26 shows the method of ripping a piece of wood held in the vice; this method is, of course, only suitable for short lengths. Figs. 20 and 24 show two common faults.

Fig. 19.—Front View showing Saw Blade and Elbow in Same Plane

Fig. 20.—Defective Sawing: Saw Too Upright

The Panel Saw.—This saw has come more and more into use of late years, owing largely to the introduction of machinery and machine sawing for large stuff. It is the most useful all-round saw that a woodworker possesses. It can be used for cross-cutting, ripping, tenoning, and most other purposes. If a man can only afford one saw, this is the saw to get. Though it cannot be said to be as quick as a rip saw for ripping big stuff, or as a cross-cut saw for cross-cutting, or as handy as a tenon saw for small work, it will do the work of all three

Fig. 21.—First Position of Saw when Starting

Fig. 22.—End of First Up-stroke

Fig. 23.—Correct Slope for Saw

Fig. 24.—A Common Defect: Using Saw at too little slope

and leave the cut finer than the "rip" or the "cross-cut." Its length is usually 22 in., with teeth about the same size as those of the tenon saw.

Tenon Saws.—This saw (Fig. 27) gets its name from the fact that it is largely used for sawing tenons, for which purpose it is especially suitable owing to its length, size of its teeth, thinness of blade, etc. Along the top edge of the blade is

Fig. 25.—Method of Ripping largely used by Cabinet-makers

a strip (called the "back") of grooved steel or brass into which the blade fits; this gives strength and rigidity to the thin blade, thus enabling greater accuracy in sawing to be obtained. The tenon saw is often known as a "back" saw for obvious reasons.

Using the Tenon Saw.—This saw is used chiefly for bench work. In sawing, a bench hook is often used for holding the timber. The bench hook may be cut out of the solid (Fig. 32) or made by nailing two small blocks on a strip of wood about 10 in. long; *see* Fig. 33. When sawing, the bench hook is hooked against the front of the bench and the timber to be sawn is pressed against the top block of the hook with the left hand and firmly held (*see* Fig. 37). A piece of timber insecurely held when sawing means time wasted, inaccurate work, buckled saws, and possibly cut fingers.

Fig. 34 shows a wider type of bench hook. Owing to the top piece stopping off short, there is less likelihood of mutilating the bench with the saw.

In using the tenon saw, one or two

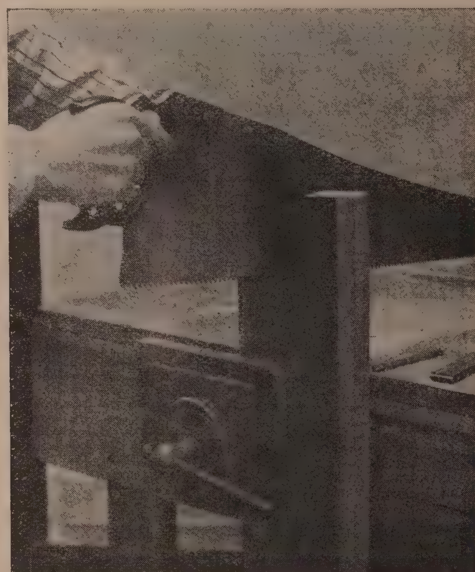


Fig. 26.—Ripping Short Length in Vice

up strokes should first be made. Start sawing with the saw inclined at about 30 degrees (Fig. 35) and during sawing gradually bring the handle down until the saw is level and the strokes are level (Fig. 36).

Tenon saws are 12 in. to 18 in. in length, the usual size in use being a 14 in. The number of teeth to the inch is about ten.

Adjustable "back" or tenon saws are occasionally met with; *see* Fig. 31. Both the top and bottom edges of the blade have teeth, and the steel rib can be adjusted anywhere down the blade, thus adapting the saw for any depth of cut. These saws do not seem to have

"caught on," and the trained craftsmen seldom possesses one.

Dovetail saws (Fig. 28) are similar in shape to a tenon saw but smaller—10 in. is the usual size—and with finer teeth, about 12 to the inch. Usually, as shown, the handle is not closed: the shape of the handle and the size are the only features

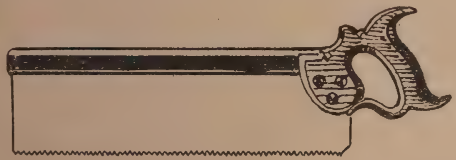


Fig. 27.—Tenon Saw

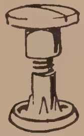


Fig. 29. —Saw Screw

Fig. 28.—Dovetail Saw

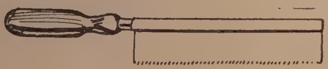
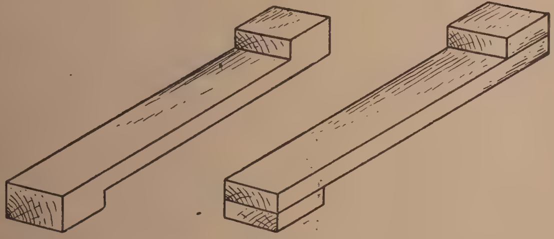


Fig. 30.—Fine Saw for Light Work

Fig. 31.—Tenon Saw with Adjustable Back



Figs. 32 and 33.—Solid and Built-up Bench Hooks

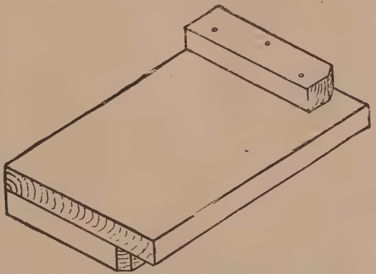


Fig . 34.—A Wider Bench Hook

Fig. 35.—Using Tenon Saw : Starting

Fig. 36 —Tenon-sawing: the Cutting continued

that distinguish it from a tenon saw. As the name implies, a dovetail saw is used chiefly for cutting dovetails and for other small work.

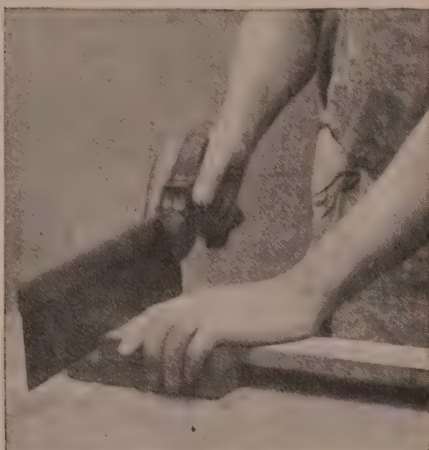


Fig. 37.—Using Bench Hook for Sawing

Fig. 38.—Tightening Saw Screw with Brace and Forked Bit

The handles of all the foregoing types of saws are fastened to the blades by saw screws. If the handle becomes a little loose it can be remedied by tightening these screws. Some of these screws have to be tightened by means of a forked brace-bit (*see* Fig. 38). A better type of saw screw that can be tightened with an ordinary screwdriver is shown in Fig. 29.

A small hardwood-handled light brass-backed saw is shown in Fig. 30. It is suitable for small work, such as cutting beading.

The Bow Saw.—This tool is not so largely used as formerly owing to the use of band saws; it is used for cutting shaped work by hand. The saw (Fig. 39) may be bought, or can be readily made as given in the details in Fig. 41.

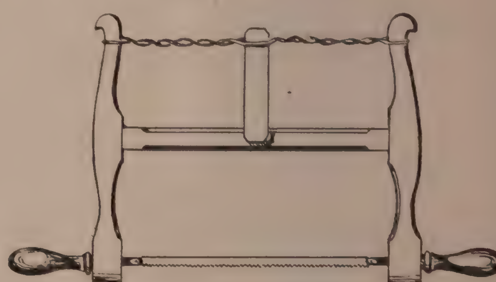


Fig. 39.—Bow Saw

Fig. 41 shows a form of bow saw which has stood the test of everyday workshop use for fifty years, and is still as useful as ever. By redrawing the squares shown at the left-hand side the worker should easily get the correct shape for the arms. The bow saw frame is made of beech, the arms being of $1\frac{1}{8}$-in. thick stuff at the handles, tapering to $\frac{5}{8}$ in. full at the top ends, all sharp edges being rounded off. The centre bar is of $\frac{3}{4}$-in. square stuff. The right-hand centre-bar joint is shown in section to explain clearly how the pivoting joint is formed. The bar shoulders, instead of being cut square, are rounded as at A to suit the corresponding hollows, which are cut out right across the inner sides of the arms; also, the bar tenons are merely stump-tenons $\frac{3}{8}$ in. or so long, rounded from the extreme ends to the shoulders as at B, and they are made a working fit for the shallow sockets in

Fig. 40.—Using Bow Saw

Bow-saw handles and blades can be obtained separately from tool dealers. The saw when in use is stretched tightly by means of the tourniquet arrangement; if the blade is not stretched when in use it easily breaks, besides being difficult to saw with. The blade should be slackened when not in use.

Fig. 40 shows the bow saw in use. If a closed pattern (like a keyhole) has to be cut out in a piece of timber the blade has to be unfastened, inserted through the starting hole bored in the timber, and again fastened. This is troublesome, and therefore a keyhole saw (Figs. 42 and 44) or a compass saw (Fig. 43) is often used. The former is often

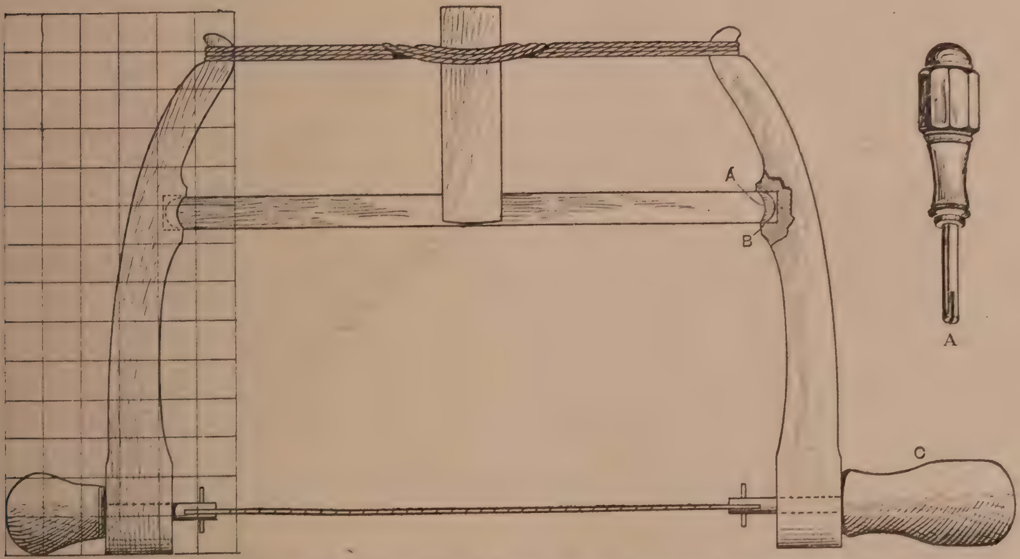


Fig. 41.—Details of Home-made Bow Saw; A, Alternative Design for Handle

which they work. The bar joint thus made forms a knuckle joint facilitating the saw tension, and also permits much latitude in using saws of varying lengths.

To give good control over the saw, the handle is made rather short and stumpy looking, shaped something like C, and the clip holes are bored right through and the ends riveted over iron end washers.

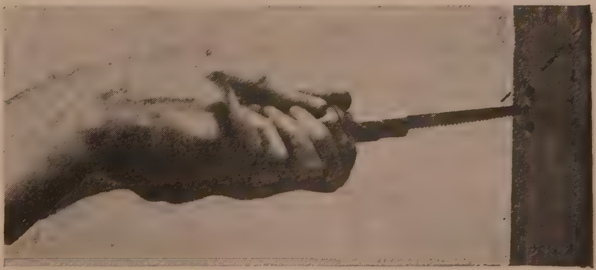


Fig. 42.—Using Keyhole Saw

called a pad saw—the handle being called a pad and being sometimes adapted to take a variety of tools; the blade fits into the handle when not in use.

A patent iron-handle pad saw is shown in Fig. 46; the wide end of the blade is shaped for use as a screwdriver.

Sometimes the compass-saw handle is made with an adjustable handle so that various blades for different classes of work may be used. A compass saw with three blades—one for sawing metal—is shown in Fig. 45.

The use of fretwork saws will be explained when an example of fretting is given in a much later chapter.

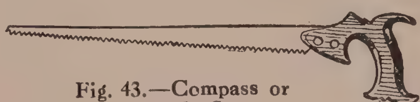


Fig. 43.—Compass or Keyhole Saw

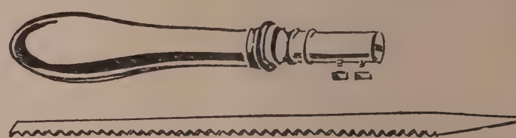


Fig. 44.—Pad Saw Handle and Blade

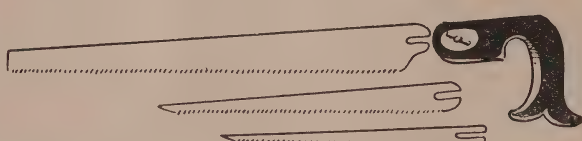


Fig. 45.—Compass Saw with Three Blades

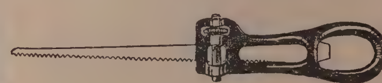


Fig. 46.—Patent Iron-handle Pad Saw

SETTING AND SHARPENING SAWS

Most tool dealers set and sharpen saws at a small cost, and many woodworkers prefer to send their saws to them rather than themselves tackle a job which is regarded as difficult. Some workers sharpen their own saws four or five times until, owing to lack of skill, the teeth have become uneven, and the saws have then to be sent to the saw expert. Saw sharpening is not really difficult, and the following instructions, which apply to most kinds of saws, should enable anyone to sharpen saws easily and efficiently.

Saws become dull chiefly by sawing gritty timber, "catching" nails, etc. A dull saw on examination will show a speck of white on each tooth "point," whereas a tooth in good condition should have a sharp point.

Saw Setting.—The saw may or may not require setting. If it saws easily, making a wide saw kerf, it will not require that treatment. The saw may be set after being sharpened, but the other way is the more usual.

A saw may be set in a number of ways. The average workman uses a saw-set, the simplest type of which is shown in Fig. 47 and consists of a handled piece of steel containing a number of slots or notches, which are of various sizes to suit different thicknesses of saws. A slot is fitted over a tooth and the saw-set handle pressed downwards until it is judged that the tooth has been bent enough; that is, until it has been given enough set. This process is repeated with every alternate tooth on one side of the saw (*see* Fig. 51). The remaining teeth are then set from the other side.

In this method of setting the operator can only guess that each tooth has an equal amount of set. Some saw-sets of this type are therefore provided with a gauge (Fig. 48), which is so adjusted that when the tooth is bent sufficiently the gauge touches the side of the saw

blade. In this way each tooth is given the same amount of set.

Plunger saw-sets are now largely used (*see* Fig. 50). On pressing the handles together the plunger is pressed against the tooth; when the handles are released the plunger springs back. The saw-set can be adjusted for various sizes of teeth by turning the revolving disc, which is numbered for different sizes of saws. There are numerous variations of this type of saw-set, Figs. 49 and 52 showing two varieties in use.

Setting saws by placing them on an iron block and hitting the teeth with a hammer is the oldest and most rapid method, though it is only recommended for use by the expert or for one who has a lot of saw setting to do. The average woodworker seldom uses this method. Fig. 53 illustrates the block and Fig. 54 the special saw-setting hammer. The iron block is about 7 in. or 8 in. long, with the top edges bevelled off as in the illustration. The bevelled edges should be of different slopes so that they will do for different sizes of teeth. The saw is then held flat on the block with the

Fig. 47.—Notched Saw-set

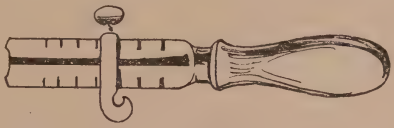


Fig. 48.—Notched Saw-set with Gauge

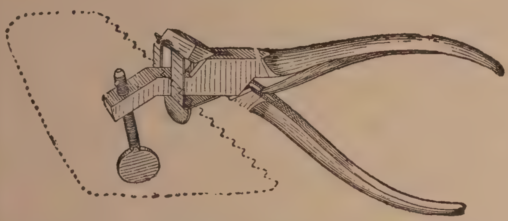


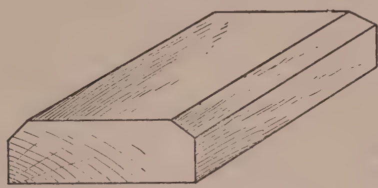
Fig 49.—Setting Saw Teeth with Plier-type Set

Fig. 50.—Another Variety of Plier Saw-set

Fig 51.—Using Notched Saw-set

Fig. 52.—Using Plier Saw-set

teeth projecting over the bevel and each alternate tooth struck with the hammer. The saw is then turned over and the process repeated. The bevel edge with the most slope and the largest end of the hammer should be used for big teeth.



F g. 53.—Saw setting Block of Iron or Hardwood

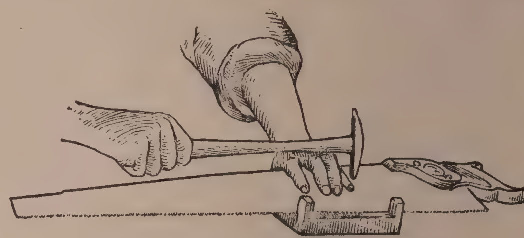


Fig. 56.—Hammer-setting Saw on Ætna Block

Fig. 54.—Saw-setting Hammer

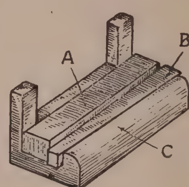


Fig. 55.—Ætna Saw-setting Block

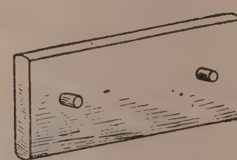


Fig. 57.—Saw-setting Block for Use in Vice

A saw-set of the above type, called the Ætna, is illustrated in Fig. 55, in which A is a steel block with the edges bevelled at different angles; B is a steel wedge, and C is a casting to hold the block and wedge. Fig. 56 shows the saw-set in use.

A block of iron, about 5 in. long, with a rounded top edge, as Fig. 57, is sometimes used fixed in the vice, the pins in the side preventing the block being knocked down in the vice by the hammering.

Fig. 58.—Setting Saw Teeth with Hammer and Punch

Fig. 59.—Needle Gliding between Points of Properly Set Teeth of Saw

A method of setting saws on the above

Fig. 60.—Saw Clamps for Use in Bench Vice

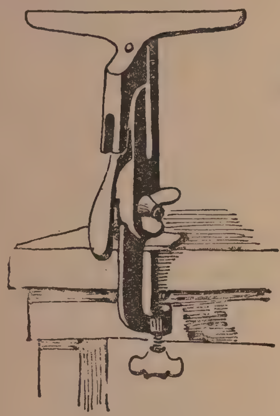
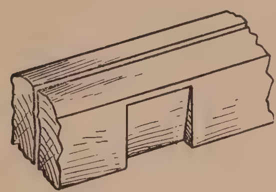


Fig. 61.—Saw-filer's Vice



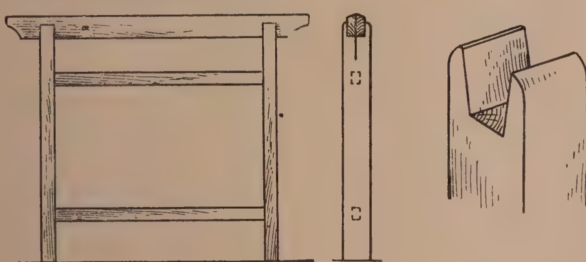


Fig. 62.—Elevation and Details of Saw Vice

lines is to use a piece of *hardwood*, as Fig. 58. Place the saw on it, and hit each tooth with a nail punch and hammer. Each tooth will be bent a little—varying with the strength of the blow—but the hardwood will prevent the teeth being bent too far or getting broken. This method is very convenient when the workman has not a saw-set to hand or for the amateur worker who does not wish to go to the expense of buying one. A hardwood block similar in shape to Fig. 53 could be used.

When an ordinary hand saw has been properly set it will allow a needle to glide down the teeth as shown in Fig. 59 (which is reproduced from a straight, untouched photograph).

Sharpening Saws.—In order to hold the saw whilst sharpening, various devices are used, the simplest consisting of two pieces of wood the length of the saw and about 2 in. by 1 in. in section (*see* Fig. 60). The saw blade is placed between these two strips and the whole tightened up in a vice. The saw should not project more than about $\frac{1}{2}$ in., or the teeth will spring or "give" when filing, but when using the saw-set of the plunger type the teeth must project more to accommodate the saw-set. Fig. 61 shows another type of saw vice.

The ordinary woodworker's bench vice is rather low for saw sharpening. A more convenient type of saw clamp of suitable height is shown in Fig. 62; the clamp pieces fit into tapered slots in the top of the stand, and when driven into position with a few taps from a hammer bind the saw blade tightly between them.

On sighting along the teeth of a dull

Fig. 63.—Topping Saw Teeth with Flat File

or badly sharpened saw it will be seen that the teeth are not in a straight line, but they are uneven. Therefore the first step in sharpening is to straighten—

Fig. 64.—Saw File

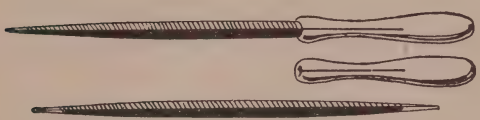


Fig. 65.—Double-ended Saw File

or reduce to an even slightly convex curve—the line of the teeth, and this is done by running a file (preferably a flat one) over the points of the teeth. It is convenient to fit a flat file in a groove cut in a piece of wood, and then if this wooden guide is held against the side of the blade, the file will be kept level and the points of the teeth consequently filed more accurately, or a large file may be used without mounting it, as in Fig. 63.

A three-cornered or triangular file, incorrectly known sometimes as a "three-square" file (Fig. 64), is required for the actual sharpening. Such files are made in various sizes, a $4\frac{1}{2}$ in. file being suitable for hand saws and a $3\frac{1}{2}$ in. for tenon saws. A double-ended saw file (Fig. 65) is very convenient and the one generally favoured. An 8 in. file is a convenient size; though rather large for panel and tenon saws, it may be used to sharpen them as well as the hand saw.

The section of the file is an equilateral triangle, and the *size* of the file will not alter the *angles* of the file, which are 60° in every case.

Begin sharpening at the handle end of the saw. The file is held level but pointing towards the handle end of the saw. (Some saw sharpeners advise that the file should be inclined a little, about 15 degrees, but this does not matter much, and it gives the teeth an uneven appearance.) The position to hold the file may be determined by laying it between the teeth so that it will file the teeth and yet preserve the former shape. The position of the file is shown in Figs. 66 and 67.

File down into each alternate gap between the teeth until the white specks (denoting dullness) on the teeth points to the left of the file are *nearly* removed. The file should only be used on the forward strokes. Two or three strokes of the file will be required for each tooth.

The tooth to the left of the file is the one that is being sharpened, but, of course, the side of the tooth to the right will also be filed a little. It is for this reason that the white specks on the teeth do not need to be entirely removed whilst doing the first side of the saw; they will be entirely removed when filing from the other side.

Sometimes, when a workman is in a hurry, he does not bother to set the saw or to run the "flatting" file over the teeth points, but simply gives each gap one or two strokes of the file. This is a quick method, and an equal amount is taken from each tooth.

When the saw has been filed from one side, it is turned round and filed from

Fig. 66.—Filing Saw Teeth

the other; taking care that the file again points towards the handle end of the saw.

If the file were held at right angles to the saw blade the gap between the teeth would be exactly 60°, but by pointing the file towards the handle this angle

is increased to about 64°. A good angle for the front (leading edge) of the teeth of a cross-cut saw is about 75°. The teeth angles will thus be as shown in Fig. 68.

The front edges of the rip-saw teeth are at about 90° to the edge (87° is shown in the diagram). The angle between the teeth will be about 62°, thus giving the shape as in Fig. 69.

The teeth of the rip saw are filed in the same manner as for a cross-cut saw,

Fig. 67.—Plan showing Angle of Saw File

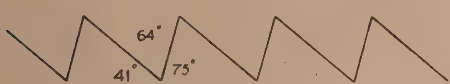


Fig. 68.—Cross-cut Teeth

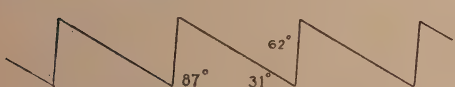
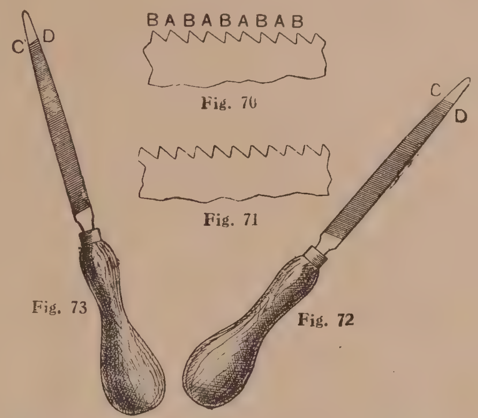


Fig. 69.—Rip Saw Teeth

but the file is not pointed so much towards the handle (from 3° to 5° out of square is about right), whilst for a cross-cut, tenon, or panel saw the file should be pointed about 20° to 30° out of square. The more the file is held out of square the finer will be the point and the keener the cutting, but the teeth will be weaker and more quickly dulled. Some experts contend that for rip saws the file should be held at 90° to the blade, each tooth then acting as a small chisel; but as the grain of timber is always more or less curved it is better generally to point the file towards the handle as before stated. For saws that are used mostly for cross-cutting soft wood a fine sharp tooth that will easily cut its way through soft fibres is desired, and this is obtained by holding the file more obliquely to the saw blade, say about 60° (30° out of square). For hardwood the teeth are better if less acute, and the file is held at about 70° to 75° to the face of the saw (15° to 20° out of square)

Panel, tenon, dovetail, and compass saws are sharpened as for a cross-cut saw, but it is desirable to use a little



Figs. 70 to 73.—Diagrams showing Effects of Varying the Angle at which Saw File is Held

finer file. Pad saws are made with the blade tapering quickly towards the back edge, and therefore do not require setting.

If the above instructions are followed, no difficulty should be experienced in sharpening all the ordinary types of saws, but the beginner often finds that the teeth after being filed are not even and regular. Let it be assumed that the teeth, after filing, are similar to those shown in Fig. 70, while, properly filed, the angles should be alike, as in Fig 71. Teeth A (Fig. 70) are supposed to be filed with their points towards the filer and teeth B away from the filer. The file in the first place is held at an angle similar to that shown by Fig 72, and in the second place at that shown by Fig. 73. The greater pressure in each case is on the angle C, which tends to widen the roots of the teeth A, as the filing also tends towards the points of these teeth both in the face and back filing. With such filing the teeth on one range will (as will be seen) have a faster cut than on the other range, and if such filing is continued, eventually every alternate tooth will be filed out, or the saw gets into such a condition that it will be useless. The aim

should be to hold the file at correct angles in each case and to avoid undue pressure with the thumb at the angles C (Figs. 72 and 73), for it will be clearly seen that the teeth A get most of the filing unless this is guarded against. Ease the pressure at the angle C, and increase it a little at D, so that the faces of the teeth (in each case) get their due amount of filing.

Accurate Sawing: Waste Caused by the Saw Kerf.—If a piece of wood exactly 6 inches long is sawn into halves exactly in the centre it might be thought that two 3 in. pieces would result. A little reflection will make obvious that each piece will be 3 in. long *less half the thickness of a saw kerf.* This does not matter on rough work but for good joinery, cabinet work, etc., if any joint has a gap the size of half a saw cut it is a bad job.

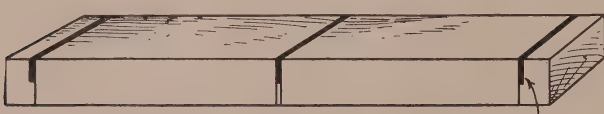
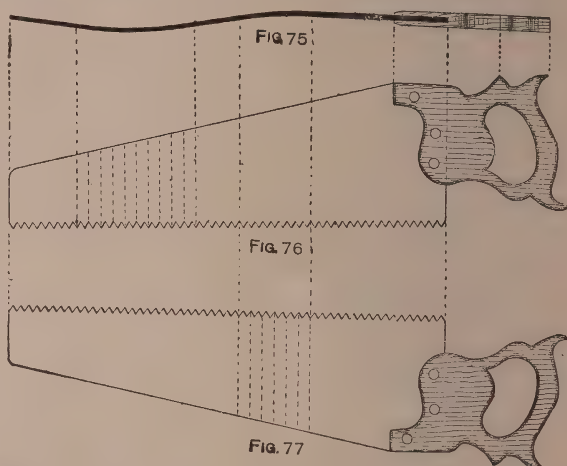


Fig. 74.—Sawing in the Waste

Suppose two pieces of wood exactly 1 ft. long each had to be cut out of a piece 2 ft. 6 in. long. First look to see if the ends of the piece are good or shaky, and square a line over one end to avoid any defects. Measure 1 ft. from the squared line and square another line; square another line over about a "bare eighth" (the thickness of the saw kerf) from this line. From the last line measure 1 ft. and square another line over the timber. If now the ends are sawn off with the saw kerfs in the waste wood and the centre sawn between the two lines the resulting pieces will be exactly 6 in. long (*see* Fig. 74).

It is clear from the above that the saw kerf should be in the waste wood, or the piece of timber wanted will be a little short. A good rule, when the timber is marked with pencil, is to try to saw so that *half the line is left on the piece that is wanted.* This will conduce to accuracy. Remember that a few extra seconds spent on accurate sawing will save minutes of fitting and planing afterwards. Get into the habit of cutting a piece exactly right length the first time.



Figs. 75 to 77.—Top, Front and Back of Buckled Handsaw

Buckled Saws.—The blade of a saw often gets buckled—that is, permanently bent—particularly when the teeth have little set and the tool is used on wet timber. Fig. 75 shows the plan of a buckled saw, Fig. 76 the front side, and Fig. 77 the back side. The curvature or buckle can be hammered out of the saw. A joiner's hammer with a slightly round face should be used so that the blade will not be marked. Saw experts use special hammers. The blade of the saw should be laid, hollow side down, on a block of iron, and the convex side hammered as shown in Figs. 75 and 76. The dotted lines show where the blades should be hammered. The saw shown will have to be hammered on both sides as indicated. In general it is better to have a buckled saw put right by an expert, as it is necessary to know beforehand the effect of every blow of the hammer.

Hammers and Mallets

THE best type of hammer for general woodworking is shown in Fig. 1 and is known as a Warrington hammer. This is the kind generally used by cabinet-makers and joiners. Some, however, prefer the London pattern (Fig. 1A). Various sizes may be obtained, but size 2 or size 3 is usual for bench work.

The head is made of cast steel; the "face" should be slightly convex so that the timber is not easily marked when the hammer hits the surface. The thin end of the head is known as the "pene," and is useful for starting small nails held between finger and thumb, or for driving nails in grooves or other restricted places.

The handle or shaft is usually made of ash; sometimes beech is used, but it is not as suitable as ash, being more brittle. Ash is tougher and more elastic, and better able to withstand sudden jars than beech. The shape of the shaft varies somewhat according to the taste of each woodworker, and also with the kind of hammer, but the shaft shown in Fig. 1 is a favourite pattern.

Fig. 1.—Warrington Hammer

Fig. 1A.—London Hammer

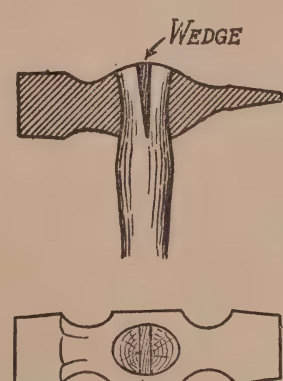


Fig. 2.—Method of Wedging Hammer Head

It is usual nowadays to buy the hammer complete with shaft, If the shaft gets broken a ready-made one can be bought or one can easily be made. The shaft is fitted into the head and a saw cut made in the shaft to receive a wedge. This saw cut is better if made across the head (as Fig. 2); this wedges the shaft in the

direction in which it has a tendency to work loose—the head has little tendency to work loose sideways. Iron wedges

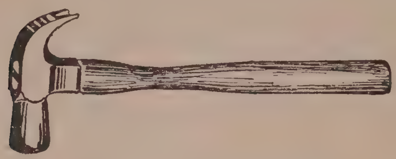


Fig. 3.—Claw Hammer

are often used instead of wood, but on the whole they offer little if any advantage. When they get rusty they often become loose and may then fall out.

When the head works slightly loose it is generally due to the wood shrinking, and may be remedied by putting the hammer in water for an hour or so. This is obviously only a temporary remedy, as when the wood again shrinks the head will again become loose, and a better method is to put in a slightly larger wedge.

The claw hammer shown in Fig. 3 is largely used by carpenters, and is useful

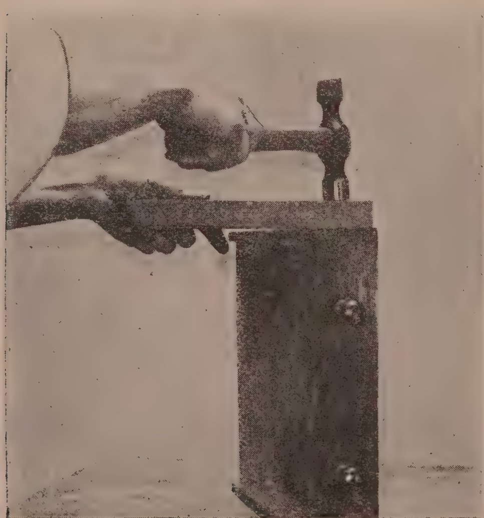


Fig. 4.—Avoiding Hammer Marks

for pulling out nails. It is the favourite American hammer. Other hammers are often used, such as upholsterers', veneerers' or saw-setting hammers, but these will be described later.

Little can be said about using a

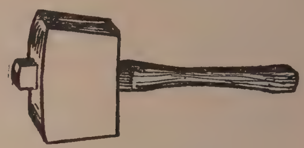


Fig. 5.—Mallet

hammer; it is mostly a matter of practice, but two common faults with beginners are that the hammer is held too near the head and held too stiffly. Hold the shaft as near the end as convenient, and, when striking, do not press or push the hammer but let it drop on the nail with a smart rap. Use the force at the beginning of the blow and then let the head drop. This hint is given because beginners often seem to pull back a little as the hammer hits the nails, etc.; they rob the blow of part of its power besides causing harder work for themselves.

In using the hammer on finished work or anything that must not be "hammer marked" a small piece of wood—a hammering piece—is used between the hammer and the work (see Fig. 4).

A mallet (Fig. 5) might be described as a wooden-headed hammer. It is used where a hammer would injure the tools, etc. It should be used with all chisels, gauges, etc., as a hammer would soon split the handles.

The mallet may be made of beech or ash. Those bought ready-made are usually of beech, but it is preferable to have the handle of ash. The hole in the head is made tapered—bigger on the wide part; the handle is also tapered and passed through the hole in the head until it tightens in the hole. Being fastened in this way, the head does not easily work loose, as in striking the tendency is for the handle to be pulled farther through the head and thus tightened more securely.

The "hitting faces" of the mallet are bevelled so as to get a straight hit at the chisel, etc.; see Fig. 6, which demonstrates

that the faces should taper towards the point about which the mallet is swung when using.

Pincers are used for pulling out nails, etc. They vary in shape and size. A 7 in. pair of the Lancashire type (*see* Fig. 7) will be found suitable. Various methods of using and the mechanical principles of the pincers will be dealt with in the chapter on nailing and screwing. Another common pattern of pincers is shown in Fig. 8.

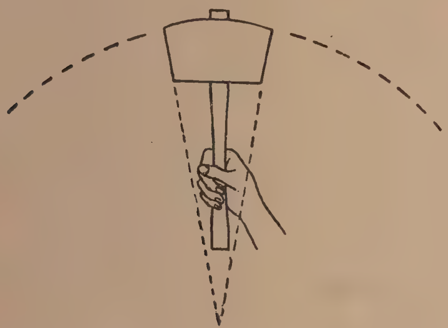


Fig. 6.—Diagram showing Swing of Mallet and Bevel of the Hitting Face

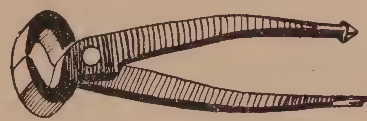


Fig. 7.—Lancashire Pattern Pincers

Fig. 8.—Tower Pattern Pincers

Chisels and Gouges

There are three chief types of chisels used by the woodworker: (1) firmer chisels, (2) paring chisels, (3) mortise chisels.

The firmer chisel (Fig. 1) is the most common type as it can be used in addition for either mortising or paring. The other is a "tang" which fits into the handle. The length of blade is about 5 in., and the chisels may be bought in different widths: from $\frac{1}{16}$ in. to $\frac{1}{2}$ in. rising by sixteenths; from $\frac{1}{2}$ in. to 1 in. rising in eights; from 1 in. to 2 in. rising in quarters.

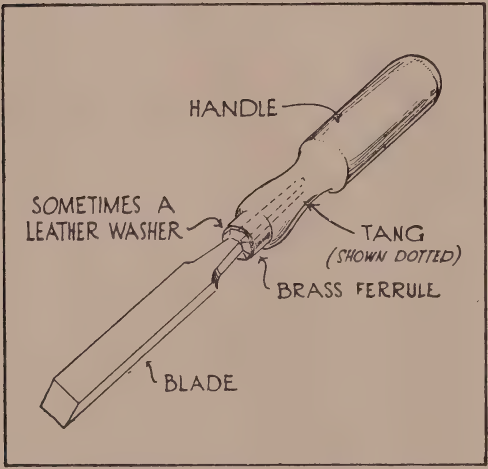


Fig. 1.—Firmer Chisel and Names of Parts

Fig. 2.—Bevel-edged Firmer Chisel

Fig. 3.—Bevel-edged Paring Chisel

Fig. 4.—Paring Chisel

handle is preferably of ash and, to prevent splitting, should have a brass ferrule as shown. As a further precaution against the handle splitting, a leather washer is often inserted between the edge of the handle and the shoulder of the "tang."

The blade is of cast steel and is ground and sharpened at one end, while at the

The chisel blade is often built up of two kinds of steel. Hard steel is necessary for the cutting edge, but if all the blade were made of this steel it would be difficult to grind. The blade, therefore, consists mostly of softer metal except at the cutting edge and is consequently tougher and less liable to snap.

The two kinds of steel can be easily seen on examining a bright chisel or even more clearly on looking at a plane iron. (*See* Fig. 5.)

The edge of a chisel has two bevels—a grinding angle and a setting or sharpening angle. When bought a chisel is simply ground and has to be sharpened

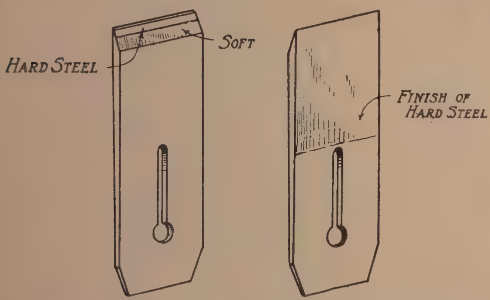


Fig. 5.—Front and Back of Plane Iron showing the Built-up Blade

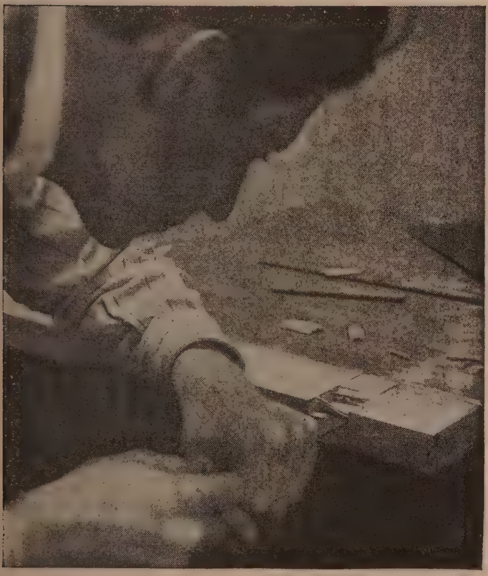


Fig. 7.—Chiselling Slot : Correct Method

before using ; in sharpening, this bevel is not kept flat on the oilstone with the result that the sharpening angle is formed (*see* Fig. 6).

A bevelled-edge firmer chisel is shown in Fig. 2. It is generally used for paring, for which it is more suitable than that shown by Fig. 1, but it is not suitable for heavy work or mortising. It is of the same length and may be obtained in the same widths as firmer chisels.

Two types of paring chisels are shown in Figs. 3 and 4, one having bevelled edges. These chisels are thinner than firmer chisels and the blade is about

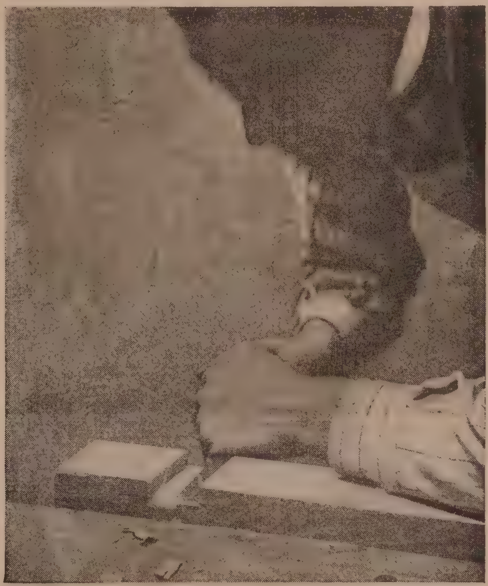


Fig. 7A.—Chiselling Slot : Incorrect Method. Note the Piece Splintered off the Back by Chiselling Through

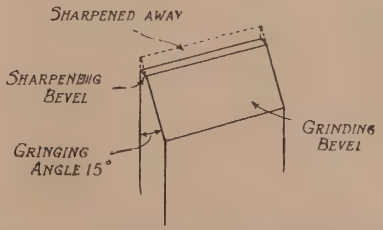


Fig. 6.—Chisel Blade, showing Grinding and Sharpening Angles

twice the length. These long paring chisels are not much used by the average woodworker, being chiefly used by pattern makers. The firmer bevelled-edged chisel is suitable for paring, in fact, this chisel is sometimes called a paring chisel.

Using Firmer and Paring Chisel.—Fig. 7 shows the method of holding the chisel when chiselling a slot in a piece of wood, the sides of the slot having first been sawn down with the tenon saw. The slot should be chiselled from both sides; if the slot is chiselled straight through from one side there is a liability of breaking off the corner or edge of the slot at the other side as Fig. 7A. It is better to chisel half way through and take off a little amount at each cut until the right depth is reached. Then turn the wood round and finish from the other side.

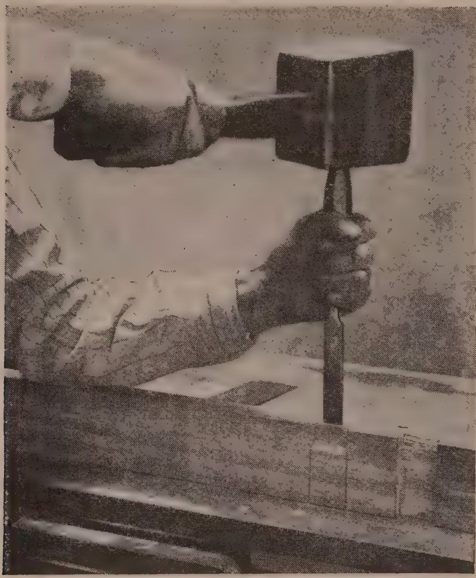


Fig. 8.—Using Mallet when Making Slot in Large Work

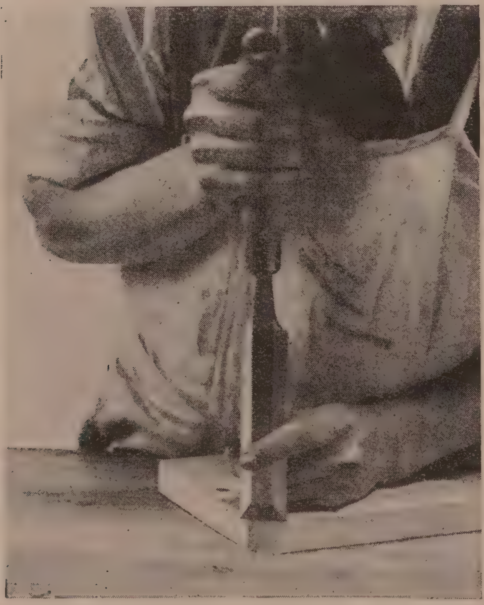


Fig. 9.—Chiselling Small Corner

If the timber is for a big and rough job the slot may be chiselled by laying the wood on the bench and using the mallet and chisel as Fig. 8. In paring in the direction of the length of a piece of wood always try to chisel with the grain. If the wood were chiselled in the other direction the chisel would dig in and tend to split the wood. An example of this is when chiselling a corner. This may be done by laying the wood flat on the bench and chiselling vertically as Fig. 10. Care should be taken to work inwards towards the end of the wood. If the end is chiselled by working outwards towards the edge of the wood a split is likely to occur as in Fig. 10A.

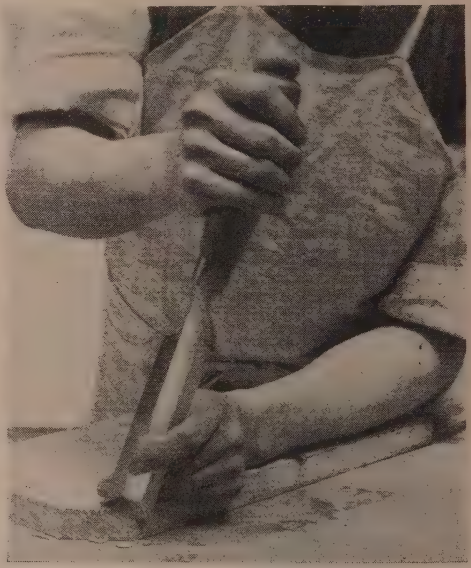


Fig. 10.—Chiselling Corner: Correct Method

Where the corner is smaller than the chisel the above precaution is not necessary and the chisel is held as shown in Fig. 9.

If the corner is very large it is better to fix the wood in the vice and pare the corner horizontally (more or less); care should be taken to pare in the direction from the edge to the end of the wood, otherwise there is a tendency to split off a portion of the corner (*see* Fig. 11).

When paring the end of a piece of wood it is easier to take off a little at a time as in Fig. 12.

In using chisels always try to keep

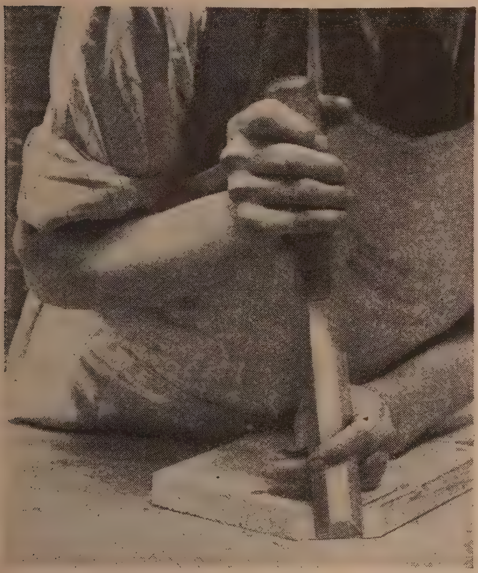


Fig. 10A.—Chiselling Corner: Incorrect Method. Note the Split

both hands behind the edge of the chisel and thus avoid accidents.

Mortising Chisel.—This type of chisel is not so much used in workshops as formerly owing to the employment of mortising machines. Though a firmer chisel is not so good for mortising it will perform the work satisfactorily. Two types of mortise chisels are shown by Figs. 13 to 14A, the second being of the socket type. It will be seen that these chisels are much stronger than firmer or paring chisels.

Fig. 15 shows a mortise chisel in use.

In cutting a mortise hole, start at the centre of the mortise and work towards the end of the hole. Hold the chisel upright and drive into the mortise as far as convenient but so that the chisel does not stick; repeat this in steps

Fig. 11.—Paring Corner Horizontally

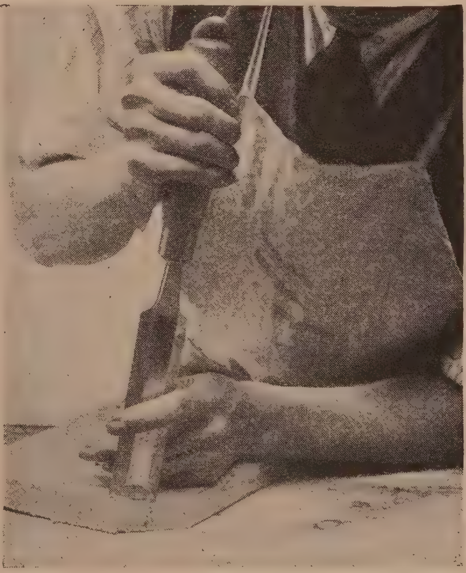


Fig. 12.—Take Off a Little Only at Each Cut

backwards of about $\frac{1}{8}$ in. until the end of the hole is reached. For the last cut do not put the chisel quite on the line (the limit of the mortise) but a trifle nearer the centre of the mortise to allow for the

Fig. 13.—Mortise Chisel

Fig. 16.—Mortise Lock Chisel (Without Handle)

Fig. 14.—Socket Mortise Chisel (Without Handle)

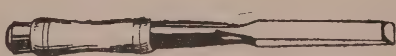


Fig. 14A.—Socket Mortise Chisel with Ferruled Handle

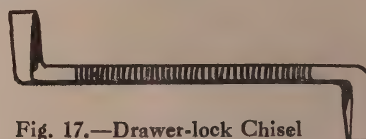


Fig. 17.—Drawer-lock Chisel

chisel "drifting" a little as it is forced down. When this is done, start again from the centre of the hole and work towards the other end. Just before getting to the end of the hole some of the waste wood may be prised out with the chisel. Do not prise with the chisel off the end of the mortise or the corners or edges of the work will be spoiled. Removal of waste wood should only be done if strictly necessary, as usually it is a waste of time, besides tending to make a poor job of the mortise. The woodworker should have in his mind that a mortising machine only works with an up-and-down motion, and the closer the hand method to this the better.

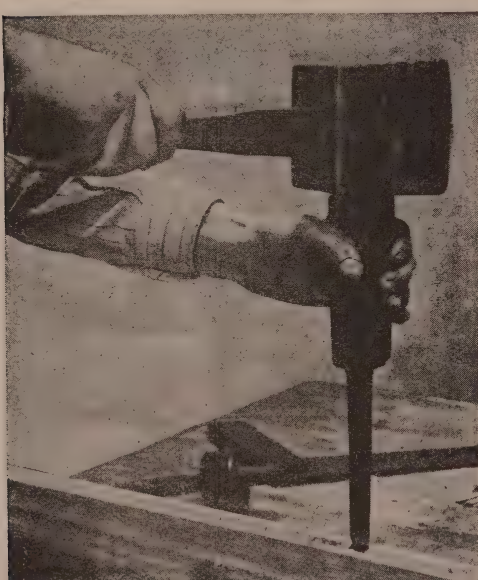


Fig. 15.—Using Mortising Chisel

When the wood has been mortised from one side, turn it over and complete from the other. Usually it will be better to hold the wood in the vice, particularly when working from the second side, as the core (waste wood) can be more easily removed. If the wood is too big to go in the vice raise it on two pieces of wood on the bench.

Sometimes a piece of wood (called a "drift") is used for driving out the waste wood from the mortise after using the chisel, but it is mostly used in machine mortising.

If a firmer chisel is used for mortising care should be taken not to break it; this readily happens when the chisel has been driven into the wood and the operator presses on it sideways to loosen it.

Some other Chisels.—Coachmakers' chisels are long, thick firmer chisels suitable for rough work and mortising. One of these chisels, about ½ in. wide, is convenient for use in fitting mortise locks, but there is a special mortise lock chisel (*see* Fig. 16).

A drawer-lock chisel is shown in Fig. 17. Its cranked shape makes it suitable for cutting the bolt hole for a drawer, it being difficult to use an ordinary chisel for that purpose.

A pocket chisel has a thin blade and is used mostly by joiners, chiefly for cutting the fronts of the weight pockets in vertically sliding windows.

GOUGES

A gouge (Fig. 18) may be roughly described as a chisel of circular curve. There are two chief varieties: inside ground and outside ground (Fig. 18). Fig. 19 shows a paring gouge inside ground. The inside ground type is usually the more convenient to use and the more difficult

Fig. 18.—Firmer Gouge, Outside Ground

Fig. 19.—Paring Gouge, Inside Ground

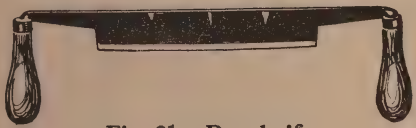


Fig. 21.—Drawknife

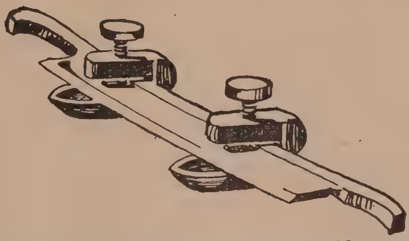


Fig. 23.—Attachment for Drawknife when Chamfering

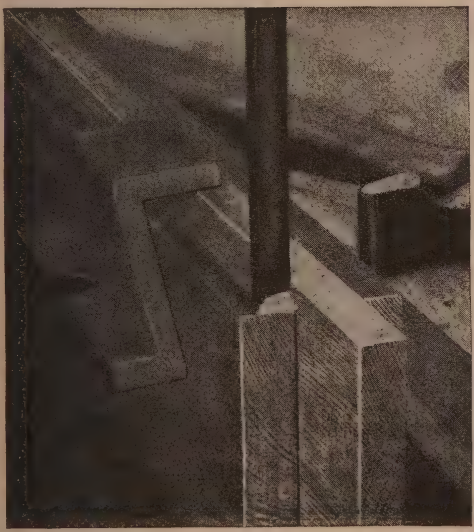


Fig. 20.—Scribing a Joint with Gouge; the Wood is Ovolo Moulded

Fig. 22.—Cutting Chamfer with Drawknife

to grind and sharpen. For the grinding an emery wheel is required. The use of an inside-ground gouge for scribing a joint is shown in Fig. 20.

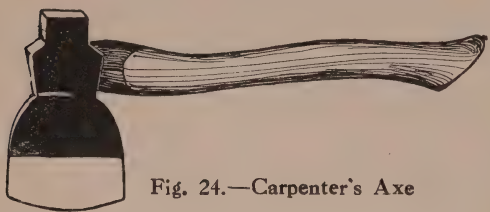


Fig. 24.—Carpenter's Axe

There are firmer gouges and paring gouges made in various widths from $\frac{1}{8}$ in. to $\frac{1}{2}$ in. They are also made in various curves in each size, that is, each size can be obtained in about six sweeps, from very flat, hardly differing from a chisel, to a very quick curve.

The Drawknife.—This tool (Fig. 21) is not so much used as formerly owing to the introduction of machinery, but it is still useful for many jobs such as chamfering. Fig. 22 shows it being used for the latter purpose, and Fig. 23 shows a special attachment for the same purpose. It is a useful tool for the wheelwright and for many kinds of rough work.

The Axe and Hatchet.—These tools (Fig. 24) are used for rough work only and often come in useful where a heavy hammer is required. Two of the commonest jobs for which the small axe or hatchet is used are rough scribing and making wedges. Suppose, for example, that a board had to be fitted to a brick wall or a skirting board to an uneven floor, the board would be first scribed with the compasses (*see* Fig. 71, p. 42) and then chopped to the line with the axe or hatchet. The latter is the name given to a small axe.

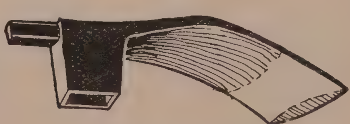


Fig. 26.—Adze

In making wedges or plugs for insertion in wall joints, etc., for fixing purposes, the wedges are usually chopped to size with the axe. The wedge should be kept steady by pressing the knee against the hand holding the wedge (Fig. 25) Unless the wedge is held firmly and the axe used with care an accident may easily result.

The Adze.—This tool (Fig. 26) is used chiefly by wheelwrights and shipbuilders, but it is seldom used in ordinary woodworking. Just as the axe is used for vertical cutting, so the adze is employed for horizontal cutting and splitting.

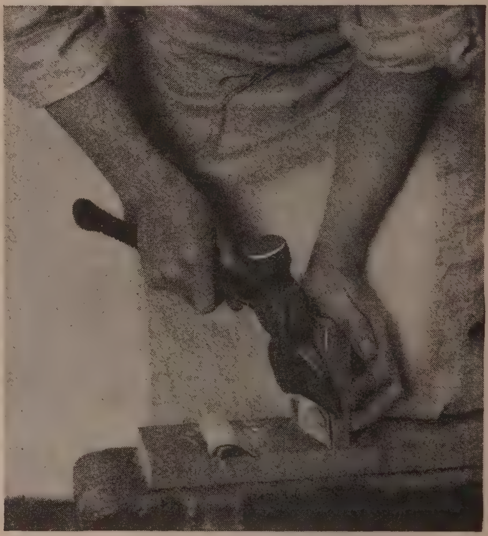


Fig. 25.—Chopping Wedge (for Wall Plugs, etc.) with Axe. Note how the Wedge is Firmly Held by the Hand supported by Knee

Grinding and Sharpening Tools

To produce a cutting edge on all edge tools such as chisels, gouges, and planes, two processes are necessary: grinding on a grindstone and sharpening on an oilstone.

When tools are bought they are usually found to have been ground to the correct angle, but not to have been sharpened. So before using they have to be sharpened on an oilstone.

Chisels and plane irons are made up of two varieties of steel: a hard portion to form the actual cutting edge, and a soft portion to make the blade tougher, and thus prevent it from suddenly snapping. The built-up nature of the blade can easily be seen on examining a plane iron, the junction of the soft and hard steel being evident on examination (*see* page 67). The built-up blade, besides allowing of a keener cutting edge and providing strength, enables the blade to be ground more quickly.

Fig. 1.—Grinding Chisel: General Position (Water-can not shown)

The angle for grinding is about 15 degrees, as shown in Fig. 6, page 67, whereas the sharpening angle is a little more than this, as shown.

Grinding.—This is done on a revolving grindstone, which may be worked by hand or power. Opinions vary as to whether the grindstone should be turned away from the operator or towards him; many workmen prefer the stone to revolve towards them, as it is the quicker method, but is the more dangerous one. The blade to be ground is simply pressed on the stone at the correct angle, and the revolving stone grinds the tool.

It is necessary to keep the stone wet, which is generally done by allowing water to drip on it from a can above. If the stone is not kept wet the blade gets hot and loses its hardness. A usual sign when the blade is getting too hot is that the edge turns a dark blue. Thus dry grinding is liable to "temper," that is, reduce the hardness of a tool.

Holding the tool in the hands whilst

grinding is usual (*see* Figs. 1 and 3), but it is tedious and requires much practice to produce a correctly ground bevel. The blade is therefore often levered against the stone as in Fig. 2, which shows a good method, one that is quick and safe to use if the stone is revolving upwards from where the chisel is placed; on the other hand, if the stone is revolving downwards there is a marked tendency for the blade to be dragged downwards and the fingers trapped; hundreds of accidents have occurred when using this method,

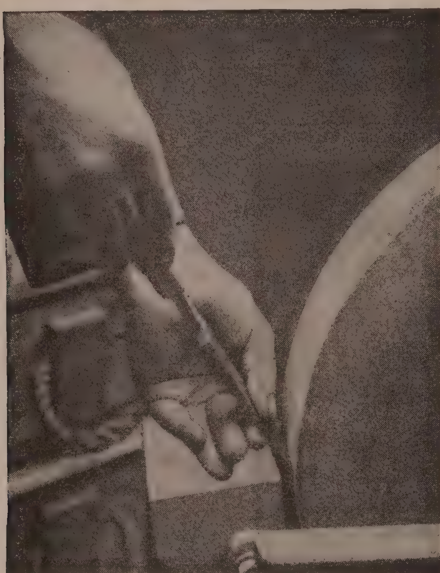


Fig. 2.—Grinding Chisel held Downwards, Grindstone Revolving Upwards

and it should be avoided as positively dangerous.

Various devices have been invented for holding the tool at the correct angle for grinding, but few of them have "caught on" for ordinary use.

Probably the best of them is shown in Fig. 4; a frame is pivoted to one side of the grindstone and the blade to be ground is fixed in this frame. More pressure can be used by this method, but the weight of the frame itself is sufficient to keep the blade in contact with the grindstone. A good finish is obtained by this device, and previous experience is not necessary.

The tool-grinding rest shown by Fig. 7 is a cheaper device, but not so good. Though a better and straighter angle could be obtained by the beginner with this rest than without it, its use will absorb both time and effort, as part of the pressure on the stone is taken by the rest itself.

In grinding chisels or gouges, care should be taken to use the edges as well as the centre of the stone, which otherwise is rendered unsuitable for grinding wide plane irons. But even though every care is taken, the grindstone will require "levelling" on the edge periodically. When it gets worn out of the circle, say $\frac{1}{2}$ in., it should be trued up; this is best done when the stone is dry. The uneven wear may be due to soft places in the stone or to keeping part of the stone under water. The grindstone is levelled by pressing the end of a piece of hard iron or steel pipe, say a piece of old cycle tube, against the edge (Fig. 8); the tube is held firmly on a rest (not shown) and moved to-and-fro across the uneven edge of the revolving stone. Sometimes two old flat files or two short pieces of flat bar iron and a piece of stout hoop iron about 18 in. long are used; lay the hoop iron between the other pieces, allowing the end to project about $\frac{1}{4}$ in., and with this tool turn the stone away. Turn over the tool occasionally to keep a good cutting edge presented to the stone.

Grinding may be thoroughly well done on an artificial or manufactured wheel, say of emery or carborundum. Gouges (inside ground) cannot be conveniently ground on a grindstone, and they require one of the stones just mentioned, especially shaped for the purpose.

Oilstones.—There are many varieties of oilstones. The favourite brand is probably a "Washita" stone, obtainable in various degrees of hardness, "soft," "medium," or "fine." The last-named puts the finest edge on the tool, but it requires the most time to do so. The "soft" is the most rapid for sharpening, but wears quickly and does not give so keen an edge. Either a "medium" or a "soft" is the best for average work.

Fig. 3.—Grinding Chisel: The More Usual Position

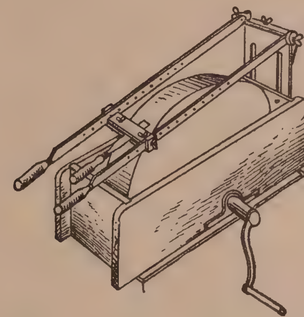


Fig. 4.—Adjustable Tool-grinding Appliance Fitted to Grindstone

Fig. 1 on page 73 illustrates the well-known treadle-driven grindstone. In many small shops this is being replaced by a geared high-speed grinder (*see* Fig. 5 herewith) employing a corundum grinding Wheel used dry (power-driven corundum wheels are, of course, available). The hand-driven wheel requires the services of two persons—one to turn the handle and the other to hold the tool

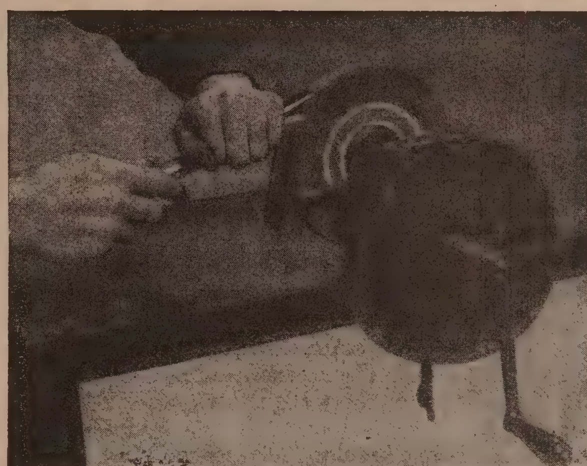


Fig. 5.—Using a Hand-driven Geared Corundum Grinding Wheel

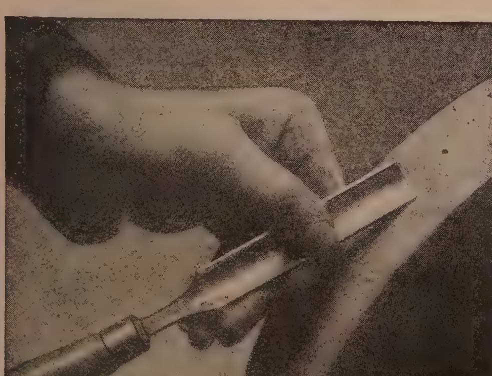


Fig. 6.—Grinding Gouge

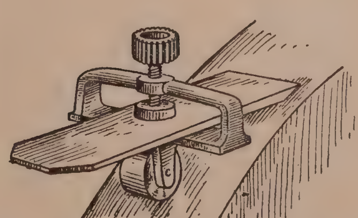


Fig. 7.—Plane Iron in Tool-grinding Rest

There are many other good varieties of stones, some natural and some artificial compositions. Most of the natural stones are quarried and sawn. The Arkansas and Washita stone is found in Arkansas

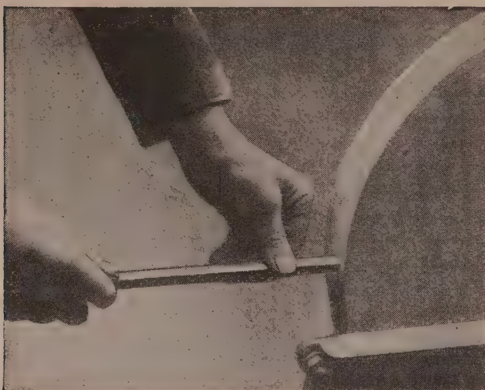


Fig. 8.—Levelling Grindstone with End of Steel Tube. (The Tool Rest is not shown)

and is quarried in summer. It is sawn by plain bands of steel without teeth, the cutting element being a stream of sand and water that is poured over the stone as it is being sawn.

The Arkansas stone is similar to Washita, but more costly and finer in grain. It is largely used for sharpening surgical instruments. Charnley Forest and Turkey oilstones are suitable for woodworkers' tools, give a fine cutting edge, but are slow-cutting.

The India oilstone is an artificial stone manufactured in America. It is made in "fine" and "medium" grades, the latter being suitable for woodworking tools. "Combination" India oilstones are made of two parts, one face medium and the other face coarse grit. The coarse side can be used for very dull tools, and the edge finally rubbed up on the medium side.

Carborundum artificial stones can be had in various makes, sizes, and grades.

Water is used instead of oil for some stones, but most stones require oil; ordinary machine oil will do and is commonly used, but neatsfoot oil—an animal oil—is the best.

The oil keeps the pores of the stone from becoming clogged with the finely ground steel, lubricates the stone, and prevents the blade from becoming so hot as to "lose its temper," that is, lose its hardness.

A special oil-can is used to hold the oil. There are two varieties of "non-leak" cans that are in common use. Both of them have a pin in the nipple that stops up the passage when the can is not being used. In one can (Fig. 8A) the pin is pressed away from the outlet when pressing the can bottom with the thumb. In the other type the pin (projecting from the end of the nipple) is pressed on the oilstone to let the oil out of the can.

Oilstones may be bought separately or in ready-made boxes. A rough box may be easily made (it is usually "chopped out of the solid," *see* Fig. 9) and the stone fixed in by making it a tight fit or bedding it in white lead; the latter is preferred as it prevents the stone being easily broken.

Two small nails are often knocked in the bottom of the box and left projecting about $\frac{1}{16}$ in., and filed to sharp points. The points stick in the bench top and prevent the oilstone sliding about whilst using.

After a stone has been in constant use for a few months it gets hollow in the centre and lumpy at the ends. In this state it is unsuitable for sharpening tools, particularly plane irons, and it therefore needs to be "rubbed down."

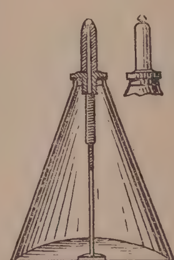


Fig. 8A.—Bench Oil-can

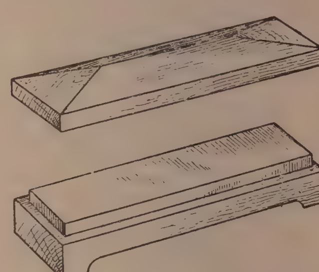


Fig. 9.—Oilstone Box Cut from the Solid

"Rubbing down" an oilstone is accomplished in two ways: on the grindstone, or on a flat stone. The grindstone is the quicker method, the oilstone simply

being held against a side of the grindstone whilst the latter revolves. Rubbing the oilstone on a flat stone is a longer process on it, using water as a lubricant, and often a handful of sand to quicken the cutting. The sand being gritty and

Fig. 10.—Sharpening Plane Iron: Usual Method

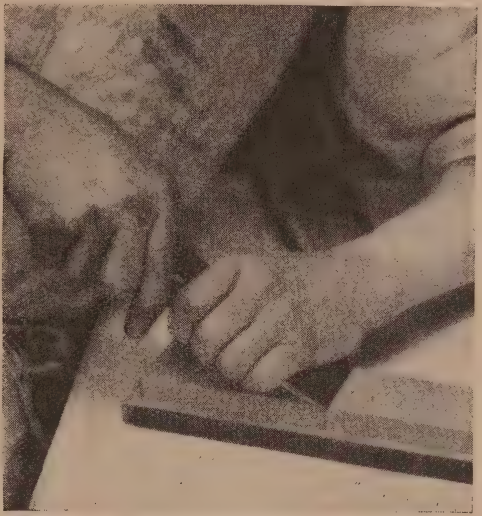


Fig. 11.—Holding Plane Iron to give more Pressure

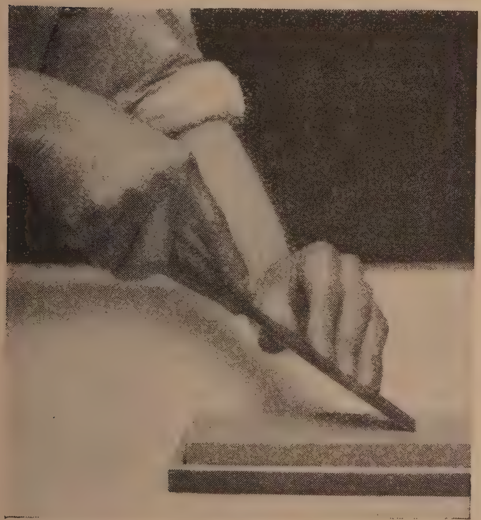


Fig. 12.—Sharpening Chisel: Correct Angle

Fig. 13.—Sharpening Plane Iron: Angle too Steep

but gives a better result. The stone (as a door-step, preferably before fixing it in a building) should have a coarse grit. The oilstone is simply rubbed to-and-fro sprinkled on the stone enables the superfluous material on the oilstone to be rubbed away more quickly. Another method is to rub the stone on a sheet

of glasspaper or emery cloth laid on a flat surface.

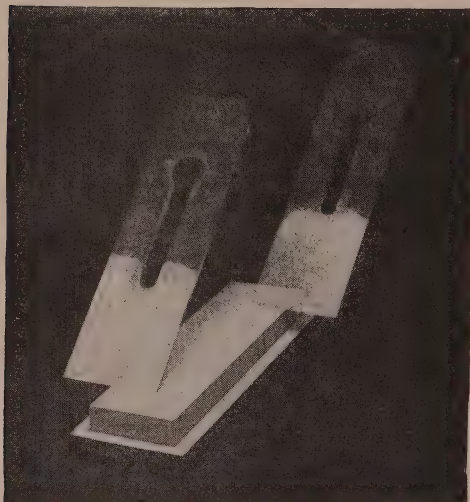


Fig. 14.—Showing the Sideways Movement as the Blade is Pushed Along

Sharpening or Setting Edge Tools.—The sharpening of a plane iron is done

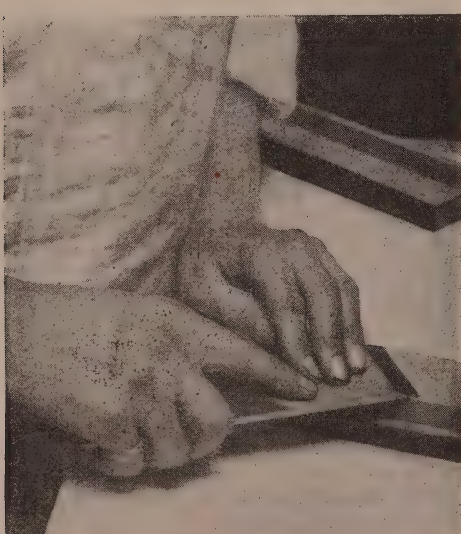


Fig. 15.—Taking Off the Burr

in the same way as sharpening a chisel; in fact, a plane may be simply described as a chisel fastened in a block of wood or iron. The adjusting of the plane iron

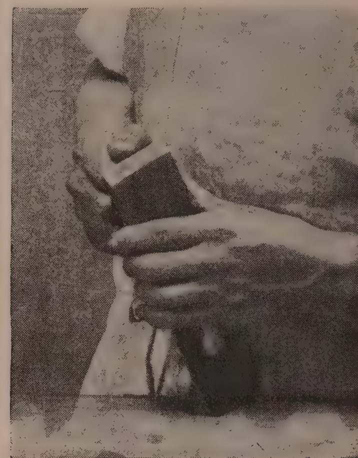


Fig. 16.—Testing the Flade for Sharpness with the Thumb

in the stock of the plane will be dealt with in the chapter on planes.

First as to the correct way of holding the tool whilst sharpening. Fig. 10 shows the usual method of holding a plane iron. The right hand is chiefly used to push the blade forwards and backwards, and the left hand to press the edge on the stone

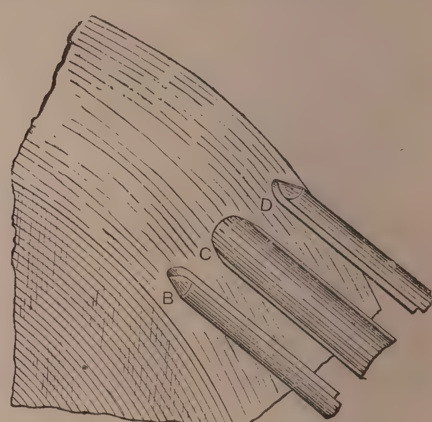


Fig. 16A.—Grinding a Gouge; B, C and D indicate Rotary Movement of Tool

but more pressure can be put on the blade by holding the left hand, as in Fig. 11.

Care should be taken to hold the tool at the correct inclination. Fig. 12 shows a chisel being sharpened at the correct angle, while Fig. 13 shows a plane iron held at too steep an angle. The best rule is to keep the angle of inclination as low as is consistent with easy sharpening. The lower the angle at which the tool is held the more metal has to be rubbed away, but the finer and better the cutting edge.

The operator should endeavour to keep the right hand at a constant height, simply gliding backwards and forwards. Avoid any up and down movements; this is the chief fault of the beginner, and is the chief defect to be guarded against.

The blade of a plane iron is not pushed straight up and down the stone, but somewhat across from corner to corner, as indicated in Fig. 14. This movement has been found to be the best for plane irons, as the edge is sharpened more evenly, but it is not so desirable for chisels, which

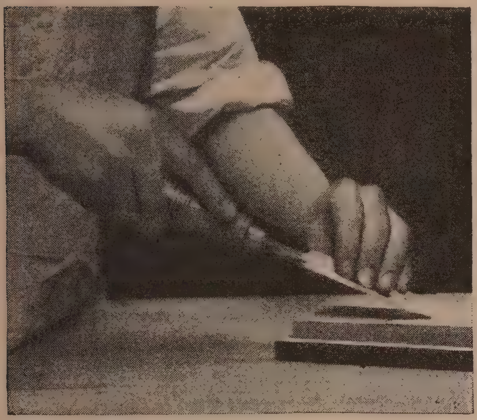


Fig. 17.—Sharpening Outside Ground Gouge

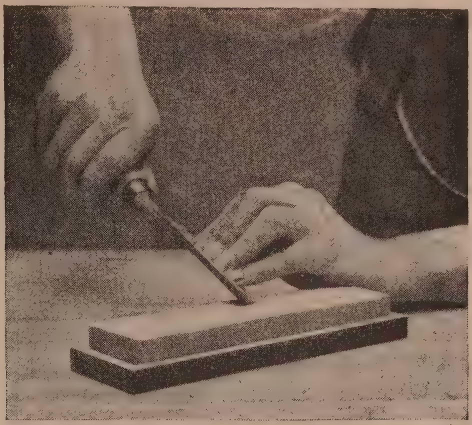


Fig. 18.—Sharpening Gouge: Another Method

Fig. 19.—Removing Burr with Finger Slip

Fig. 20.—Sharpening Inside Ground Gouge with Finger Slip

may be moved practically parallel with the sides of the stone. In sharpening a chisel it should be rubbed on the stone

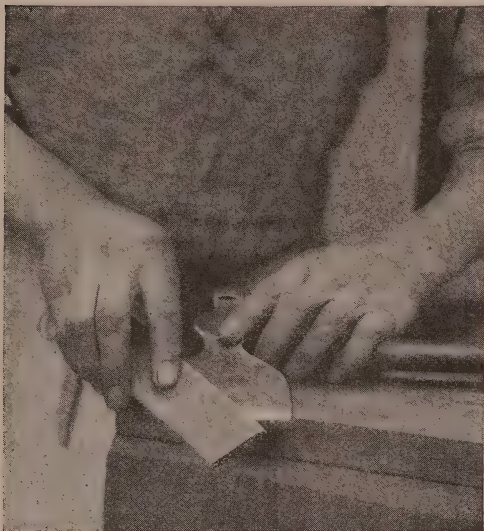


Fig. 21.—Sharpening Axe

towards the edges and not in the centre, or the stone will be worn hollow, and thus rendered unsuitable for the wide tools.

After about a minute's rubbing (for a plane iron, less time for a narrow chisel) the blade should be sharp. Sometimes a perfectly new chisel requires many minutes' work put into it. With sharpening, the edge will have burred over a little; the back of the iron is therefore laid quite flat on the face of the stone and rubbed gently backwards and forwards two or three times (*see* Fig. 15). The oil is wiped from the blade, which is then tested to see whether it is sharp enough. There are two methods of testing. Fig. 16 shows the edge being tested by drawing the thumb gently across the edge. This method puts slight cuts in the thumb and is really unnecessary, as the worker can see whether the edge is sharp or not simply by looking at it. A fine white line on the edge of the tool betrays that it is dull. If the edge cannot be seen, that is, if no white line can be seen, then the blade is sharp. The presence or not of the white line can be best observed by closely watching the edge as the iron blade is tilted backwards and forwards to catch the light. If the blade is found to be still dull it is rubbed again on the stone until judged to be sharp, and is then again tested.

Plane irons in constant use require sharpening about every twenty minutes, but the time they will keep reasonably sharp depends upon the kind of wood being planed and on whether it is quite clean. Dirty and gritty timber soon dulls a plane. Much depends on the quality of the steel blade.

Gouges are ground as illustrated in Fig. 6 (p. 75), and are rotated as in Fig. 16A.

"Outside ground" gouges are sharpened on an ordinary oilstone (*see* Fig. 17) by holding and pushing it like a chisel, but giving it a semi-rotary movement with the right hand to avoid getting any straight parts on the edge. Fig. 18 shows a different method, the gouge, in plan, being at right angles to the stone; a better edge can probably be obtained by this method but it is not as rapid as that shown in Fig. 17. The burr edge on the inside may then be removed by using a "finger slip" (*see* Fig. 19), which is a small oilstone with rounded edges (average size about 4 in. long, 2 in. wide, and tapering from $\frac{1}{2}$ in. to $\frac{1}{4}$ in. thick). But this removing of the burr edge is hardly necessary unless the job is a really high-class one.

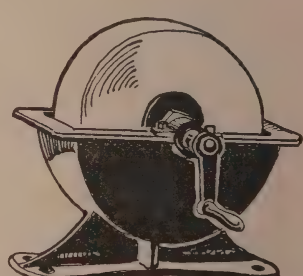


Fig. 22.—Small Hand-driven Grindstone

"Inside ground" gouges cannot, of course, be sharpened on an ordinary oilstone, and the finger slip has to be used as in Fig. 20.

The axe and drawknife are usually

sharpened by rubbing them with the oilstone ; the axe is shown being sharpened in this manner in Fig. 21.

Grindstones : Selecting and Mounting.—Grindstones are mostly obtained from Yorkshire quarries, but may come from Derbyshire and Newcastle. The colour varies, but is usually a light grey or yellow.

A dark streak through the centre, or a dark patch on one side, indicates that the stone is much harder at those places than elsewhere ; the consequence is, it will wear away faster at the softer parts and will therefore never be truly round for long together. It will wear lumpy, and at the dark places the tool that is being ground will glide over easily, and directly afterwards catch hold of the softer stone all at once, and " dig in."

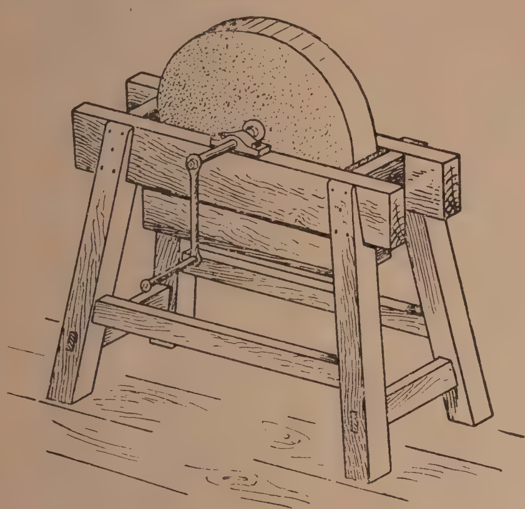


Fig. 23.—Grindstone Mounted on Wooden Frame

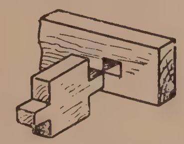


Fig. 26.—Joint of Frame of Top

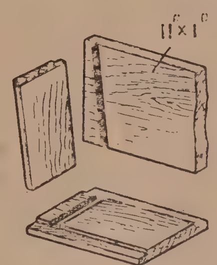


Fig. 27.—Detail of Joint of Trough

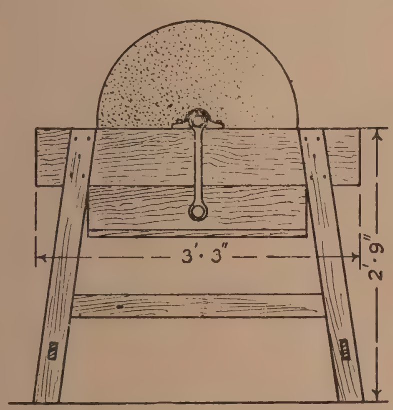


Fig. 24.—Side Elevation

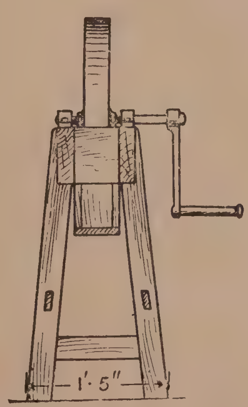


Fig. 25.—End Elevation

A stone that shows flaws on the sides, as little smooth places running into it with fine cracks showing away from the ends, should be rejected, as such a stone will not stand frosty weather; a thick stone also is undesirable—one $2\frac{1}{2}$-in. or 3-in. wide on the face being ample for the average workshop, and one much smaller is suitable for occasional grinding—as it will tend to wear hollow and in that way always be a nuisance. A smooth stone with a bluish tint should be avoided, as such a one will work harder and smoother till it becomes like a glass bottle, and of no use at all for its proper work.

Test the stone with the thumb-nail, and if that should wear it down with a few rubs backwards and forwards and leave straight marks on the nail, this shows a good free-cutting stone.

A strong frame on which to mount it may be made of 3-in. by 3-in. stuff, with the legs well spread out and braced together about 6 in. from the ground. It is sometimes a great advantage to be able to step up with one foot when grinding a thick, heavy iron or axe.

A box to hold water to place under the stone should be provided. Some prefer a can fixed above to allow the water to drip on the stone, but this has the disadvantage of throwing the water on the ground and over the legs and boots of the grinder; others dislike the box below the stone, as the water always left in the box tends to soften that part of the stone which is immersed in it. This can be avoided by having the box loose and letting the two end pieces run up longer than the sides. Let these pieces be of the same width at the top as the rails in the ends of the frame, and with a pair of butt hinges hang one end to the frame.

Nail firmly to the other end of the box a leather strap, and punch half a dozen holes in it about 1 in. apart, the end with the holes projecting above the box, and screw a stout 2-in. screw centrally into the other end rail. By this means the box with the water can be used whilst grinding, and, when finished with, it can be dropped down a couple of holes so as to clear the stone. Thus all the advantages of a box, without its drawbacks, can be secured. It can also be easily dropped right down to the ground for cleaning out, or in the event of any small tool falling into the box, as sometimes happens.

A grindstone mounted on an ordinary wooden framework without the hinged trough device is shown by Figs. 23 to 27.

The various pieces should first be planed up true, and then set out for mortising, tenoning, and notching. The pieces from which the frame of the top is made are each 6 in. by $2\frac{1}{4}$ in., and are mortised and tenoned together as shown by Fig. 26, and are fixed with nails. The legs are of 3-in. by 3-in. stuff, and the lower parts are mortised to receive the tenons of the 3-in. by 2-in. rails. The upper ends of the legs are cut so as to fit against the side of the top frame, to which they are fixed with nails. The rails and legs are fixed together by wedging the tenons in the mortising, the joints being previously painted.

Fig. 27 shows the method of securing the ends, sides, and bottom of the trough. These are made from 1-in. stuff, and before nailing them together, all the parts in contact should be coated with white lead and red lead, in order to make the trough water-tight. The trough is fixed to the ends of the top framing with four stout brass screws. A hole in the bottom, fitted with a wooden plug, allows the water to run off when it is not wanted. The woodwork should receive two or three coats of good oil-colour.

A suitable spindle and handle, with bearings, can be purchased ready-made from most tool dealers.

Mounting a Grindstone to Work by Treadle.

The accompanying illustrations show how a grindstone can be mounted on a trestle and worked by a treadle.

Figs. 28 and 29 show a grindstone mounted on a wooden frame, fitted with a trough, and the spindle cranked to receive the hooked end of a connecting rod; the other end of the rod is fastened through a hole in the foot lever. The

length of the cranked part of the spindle should be about 5 in. ; but the size and weight of the stone is the deciding factor.

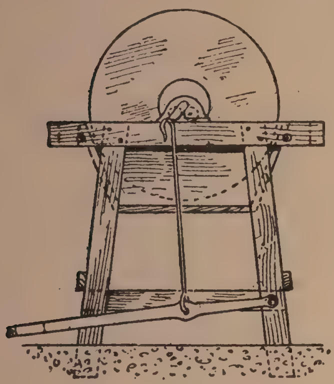


Fig. 28.—Treadle Grindstone, Side View

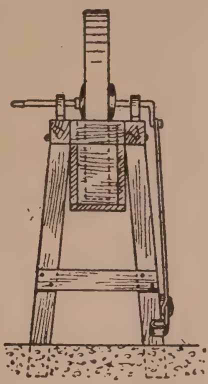


Fig. 29.—Treadle Grindstone, End View

Fig. 30.—Treadle Grindstone: Shape of Foot Lever

In Figs. 28 and 29 the crank is shown fastened to the spindle by means of a taper pin.

The shape of the foot lever is shown by Fig. 30, and other particulars can be obtained by reference to Figs. 28 and 29. Stiff bar iron or mild steel can be used, and a boss should be welded on the end

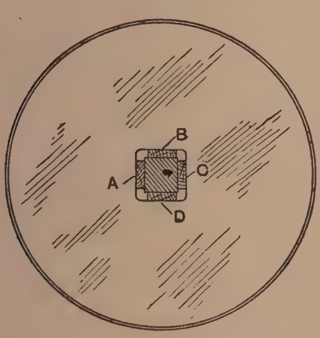


Fig. 31.—Method of Setting Stone True on Axle

that the pivot pin passes through. The looped end affords a grip for the foot, and if desired a series of chisel cuts can be made to prevent the boot slipping.

A good method for setting the stone true is to make a square hole in the centre with corners having a large radius, as shown in Fig. 31. The hole should be much larger than the square part of the spindle, to allow for the insertion of taper wooden wedges A, B, C, and D. The wedges can easily be adjusted if the stone does not run true.

A good form of spindle for a grindstone is shown by Fig. 32. The stone is mounted on the square portion A, and, after truing, secured by means of the flanges B and C. The faces of these should be hollowed out a little. If desired, two nuts can be used as shown, or one nut and a fixed collar. One advantage of having two nuts is

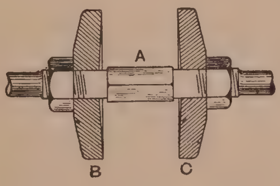


Fig. 32.—Detail of Spindle

that a thick stone can be easily placed central. Cast iron is a suitable material for the flanges or clamping plates, and mild steel for the spindle, etc.

The Plane

A PLANE in its simplest form consists of a blade fitted into a wooden or metal stock. The blade projects slightly below the bottom of the stock, and on being pushed over the surface of a piece of wood acts like a chisel and cuts into the wood, thus removing a shaving. Planes usually have a wedge or other device to hold the blade in position.

Though planes are not used as much as formerly, because of the introduction of machinery, particularly in modern well-equipped workshops, most woodworkers possess at least three planes: jack plane, trying plane, smoothing plane. These are known as the "bench planes," and are part of the necessary equipment of every woodworker.

The jack plane is used for rough work. If a piece of timber has to be planed the surface is first roughly "jacked" over, the trying plane is then used to make the surface straight and out of twist, and lastly the work is smoothed by the smoothing plane. In the case of a door or piece of framing, the jack and trying planes are used before the work is framed up and the "smoother" afterwards.

Jack Plane.—A jack plane (Fig. 1) is about 16 in. or 17 in. long, and the cutting iron is usually $2\frac{1}{8}$ in. or $2\frac{1}{4}$ in. wide. The stock and wedge are made of beech. The handle, which forms part of the body of the plane, is made from a separate piece of wood and glued in a slot formed in the top of the stock. Handles of planes are often broken—usually through knocking the plane accidentally off the bench on to the floor—in which case a new handle can be bought for a few pence, the old handle chiselled out of its slot, and the new one glued in.

Most planes are made of beech; in fact, all the wooden planes may be said to be of this timber; metal planes often have fittings and handles of rosewood or ebony. Beech is well adapted for planes; it is close grained, fairly hard, does not readily twist, and wears evenly.

On looking at the grain at the end of a plane the annual rings of the wood are easily seen. Crossing the annual rings, and nearly at right angles to them, are fine white lines called the medullary rays (*see* Fig. 2). If these white lines are at right angles to the sole, the plane will wear better and more evenly than if the lines were not upright. Of two planes that are about equal in other respects, choose the one with the more vertical medullary rays.

A plane should be "oiled" before using; this makes it heavier, lessens the friction, and thus makes the plane work easily. A reasonably heavy plane is better than a light one, as it works more solidly and does not require so much pressing down on to the work. If the plane, therefore, has not been oiled, or is too light, it should be soaked in raw linseed oil or other suitable oil until it is a suitable weight. This is usually done by suspending it in an oil tank. If this is inconvenient the cutter and wedge are

taken out, the bottom of the mouth of the plane is stopped with putty, and the mouth filled with oil. After a few days the oil will have soaked into the plane; add more oil until sufficient has been absorbed. Planes are sometimes french-polished, but this is not necessary.

The plane iron, or cutter, is shown in Fig. 3, and, as described in the chapter on sharpening, is made of steel and iron, the steel being used to give a keen edge and the iron to give toughness to the blade and also enable it to be quickly sharpened.

Besides the cutter there is also a "back iron" (Fig. 4). This is screwed to the blade, the edge of the back iron being set back a little from the cutting edge of the blade. The back iron enables the plane to work better by increasing the stiffness of the blade and breaking the shavings as they are cut by the blade (*see* Fig. 5).

Fig. 1.—Jack Plane

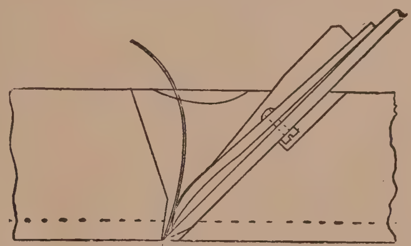


Fig. 5.—Section of Plane showing Cutting Action

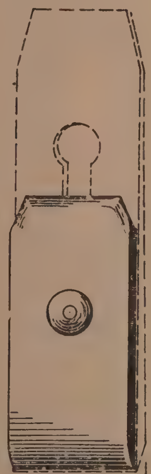


Fig. 4.—Back or Cover Iron (Cutting Iron is shown by Dotted Lines)

Fig. 3.—Plane Iron

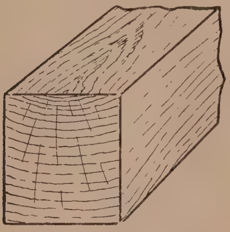


Fig. 2.—End of Plane showing Medullary Rays

Fig. 6.—Section of Surface of Wood showing Wavy Surface due to Round Plane Iron

The amount that the back iron is set back from the cutting edge is important; for a jack plane it should be a bare $\frac{1}{8}$ in. The amount of "set back" is greatest for the jack plane; for the trying plane a slightly less amount is better, $\frac{1}{16}$ in. being usual, and for a smoothing plane a bare $\frac{1}{16}$ in. is used. The jack plane is for the roughest work, and therefore the set back is greatest for this plane; the smoothing plane being used for finishing off the work, and therefore for removing fine shavings, is set the finest.

The cutting iron of the jack plane should be ground slightly convex—about a bare $\frac{1}{8}$ in. (*see* Fig. 7). This makes the plane work freely. Of course, this convexity of the plane iron causes the surface of the work to be wavy and uneven (*see* Fig. 6, which shows the unevenness exaggerated for clearness). This unevenness is afterwards removed by the trying plane and smoothing plane.

Fig. 7.—Edge of Jack Plane Iron

Fig. 8.—Edge of Trying Plane Iron

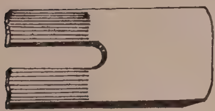


Fig. 9.—Edge of Smoothing Plane Iron

Fig. 12.—Unscrewing Plane Irons: Incorrect and Dangerous Method

Fig. 8 shows the shape of the cutting iron for the trying plane, and Fig. 9 the shape of the smoothing plane iron. It will be seen that the trying plane blade edge is the same shape as the jack plane, but with not as much curvature. The smoothing plane blade is straight, but with the corners taken off. These shapes of the trying plane and smoothing plane blades are not held to definitely, the smoothing plane often being of the shape shown for the trying plane. The main object is to remove the corners so that marks are not made on the surface of the wood whilst planing.

Taking Plane Apart.—When the jack plane requires sharpening it first has to be taken apart. The wedge and irons are loosened in two ways, as shown by Figs. 10 and 11. The easiest method is shown at Fig. 10; take hold of the wedge and plane irons with one hand and the plane

Fig. 10.—Loosening Plane Iron by Striking Plane on Bench

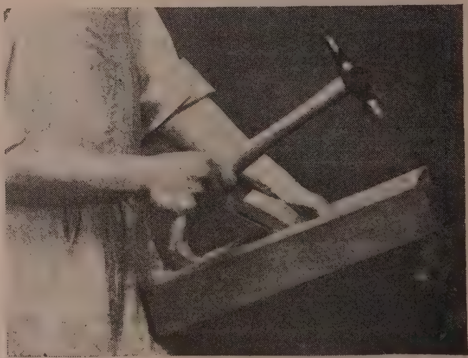


Fig. 11.—Loosening Plane Iron by Hitting End of Plane with Hammer

with the other, and hit the top of the front end smartly on the bench. This

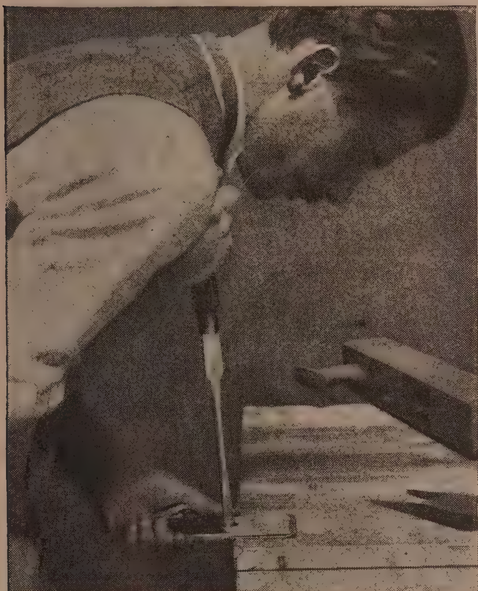


Fig. 13.—Unscrewing Plane Irons; Usual Method

Fig. 14.—Unscrewing Plane Irons by using Plane Wedge

will loosen the wedge, and the wedge and irons are then withdrawn. Fig. 11 shows the other method, which consists of striking the front end of the plane sharply with the hammer. Whilst doing this the plane should be held with the thumb in the mouth on the irons and wedge, to prevent them dropping.

Now unscrew the back iron from the plane iron. This is usually accomplished by grasping the top end of the irons in the left hand and resting the cutting end on the bench (Fig. 13). Do not hold the irons in the left hand as shown in Fig. 12, as the screwdriver is liable to slip and

Fig. 15.—Unscrewing Plane Irons by using Bench Hook

damage the hand. Sometimes the back iron screw is so tight that it cannot be loosened easily. In this case place the iron so that the back projection of the screw fits into the groove in the back of the wedge—the latter resting on the bench (*see* Fig. 14). By this method both hands can be used to the screwdriver if desired. A hole in the top of the bench or in the bench hook (see Fig. 15) will do instead of the wedge. An even better plan for very stiff irons is to screw them up in

the vice; this will help to squeeze the irons together and loosen the screw; use the screwdriver with both hands.

When the blade is sharpened the irons are put together (*see* Figs. 16 and 17) by sliding the back iron up the plane and screwing together; the plane is then held with the left hand and the blade inserted (Fig. 18). The latter is pushed forward until the correct amount projects beyond the sole of the plane, as can be seen by sighting along the sole, as shown in Fig. 20. The wedge is now inserted with the right hand—the thumb of the left hand

Fig. 16.—Putting Plane Irons in Position

Fig. 18.—Inserting Blade in Plane after Sharpening

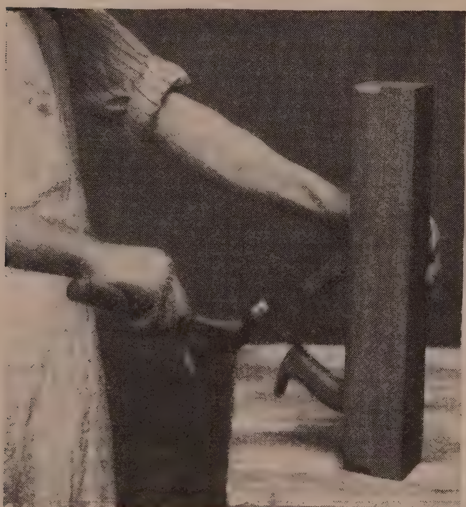


Fig. 19.—Fastening Wedge in Plane

Fig. 17.—Plane Irons in Correct Position

meantime keeping the blade in position —and then tightened with one or two taps from the hammer (Fig. 19). Whilst tightening the wedge the iron may have slipped a little; sight down the sole of the plane; if the iron does not project enough give it a slight tap with the hammer; if it projects too much hit the top end of the plane gently (as when loosening the wedge). One or two adjustments like this may be necessary; finally, when the correct amount of iron projects beyond the sole, tap the wedge again with the hammer, and so make sure that the irons are securely held in the plane. Though at first one or two adjustments of the plane may be required as above, or the plane may have to be tried to see if it takes off a correct thickness of shaving, an experienced workman can set the iron very quickly and correctly, often the first time and without trying it on the timber.

Fig. 20.—Sighting Along Sole of Plane for Projection of Blade

After years of wear and with repeatedly hitting with the hammer, the top end of the plane gets badly damaged. To prevent this a striking button, usually made of boxwood, may be fixed in the top end of the plane (*see* Fig. 21).

Adjusting a New Plane.—Planes, when first bought, or when using a new back iron or blade, and particularly when in the hands of an amateur or an apprentice, do not work easily. One of the chief faults is "choking up," that is, the shavings, instead of issuing freely from the mouth, stop up the mouth. The usual reason for this is that the back iron does not fit closely at the edge on to the plane iron, and, when planing, a shaving inserts itself in the small opening; an obstruction is thus formed and other shavings tend to stop in the mouth. The obvious cure is to file the back iron carefully until it fits the blade closely. The back iron should also be thin at the edge and smooth, so as to offer the least possible resistance to the shavings.

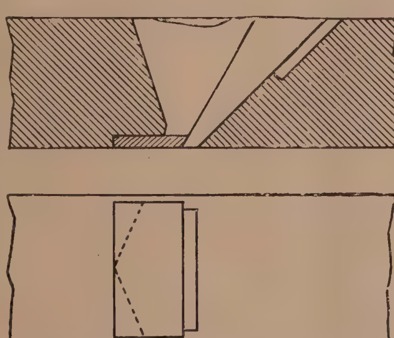


Fig. 22.—Re-mouthing Plane; An Alternative Mouthpiece is Shown Dotted

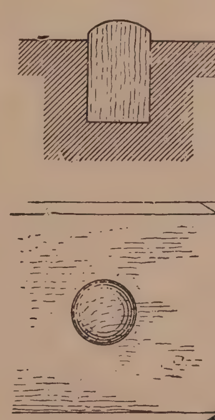


Fig. 21.—Striking Button in Plane

If the back iron is adjusted as described, the blade only allowed to project a little beyond the sole, and a smear

of oil put on the sole of the plane—particularly if planing a highly resinous wood

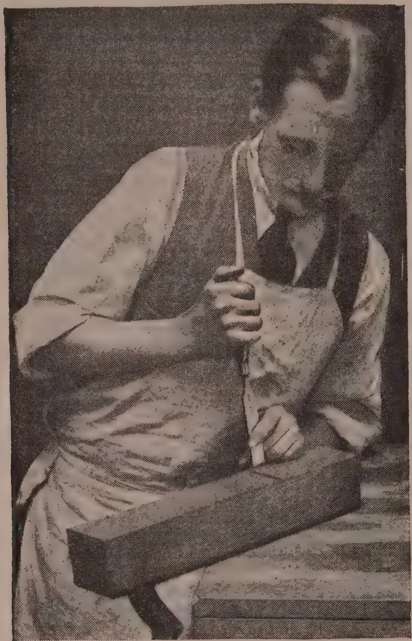


Fig. 23.—Cutting Sole of Plane for Mouthpiece

like pitchpine—the plane will probably work all right.

"Clattering" is another defect, but it usually accompanies choking up, and if the latter is remedied the former defect is usually cured also. But sometimes "clattering" (anyone who has had a plane that "clatters" will know what this is—the plane, instead of removing shavings, clatters over the wood) is due to the blade not bedding down solidly on wood stock. If this is the case the wood should be carefully pared with a chisel until the blade beds properly.

There is often a temptation when a plane which has a narrow mouth chokes, as in a new plane, to chisel the mouth wider. This should be avoided.

Shooting and Re-mouthing a Plane.—After using for many months the sole of a plane wears uneven, and it then requires "shooting." This is done by taking a few fine shavings off the sole with the trying plane. Repeated shooting and wearing of the plane will cause the mouth of the plane to become wider, as illustrated in Fig. 5, which shows that the width of the mouth is greater along the dotted line. When this happens the plane requires re-mouthing, as shown in Fig. 22. Notice that the mouthpiece extends a little beyond the ends of the mouth. Boxwood is generally used for re-mouthing a plane. A plane does not work well when it has a wide mouth because the wood just in front of the cutting edge is not pressed upon by the sole of the plane. Figs. 23 and 24 show the sole of the plane being chiselled to receive a new mouthpiece. The method of using a jack plane will be dealt with in the next chapter.

Trying Plane.—This plane (Fig. 25) is very similar to the jack plane, the only differences being the shape of the handle—which is of the closed type—and the size. The trying plane is made long—average length about 22 in.—so that it will plane the wood straight. A short plane would sink into hollows, whereas a long plane cannot do so, but removes the lumpy parts and thus makes a level surface. The materials, methods of setting and taking apart, are the same as

Fig. 24.—Chiselling Recess for Mouthpiece

for a jack plane, but the iron is wider—usually $2\frac{1}{2}$ in.—and the cap iron is set back only a $\frac{1}{16}$ in. from the cutting edge of the blade.

A special type of trying plane is called a *jointer* or *panel* plane, the length being from 26 in. to 30 in. As the name implies, this plane is used for making joints—the longer the plane, of course, the greater the tendency to plane the wood straight.

Fig. 25.—Trying Plane

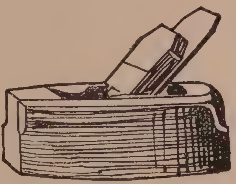


Fig. 26.—Smoothing Plane

Smoothing Plane.—A smoothing plane (Fig. 26), as the name suggests, is for smoothing or finishing a surface. As the plane is not required to straighten the timber it is of a convenient size for holding and using. The usual size is about 8 in. long with $2\frac{1}{4}$ in. cutter.

The method of taking apart, re-assembling, and adjusting is the same as for the jack plane, except that owing to the shape of the smoothing plane the back end of the plane is hammered or knocked on the bench when loosening or setting (*see* Figs. 27 and 28).

Fig. 27.—Loosening Plane Irons by Striking Back of Plane on Bench

Fig. 28.—Loosening Plane Irons by Hitting Back of Plane with Hammer

COMPASS AND TOOTHING PLANES

When hollow or round surfaces have to be worked, planes with curved soles are used. The smoothing plane is often used for convex curves if there is not much to do, but a hollow-soled compass plane is better. Concave work cannot be done with a smoothing plane, and therefore a compass plane is essential, though for small work a spokeshave (really a small compass plane) may be used.

Fig. 29 shows a wooden compass plane. Sometimes a stop for adjusting roughly to various curves is attached. In using this type of plane always keep the nose of the plane tightly against the work.

Adjustable compass (or circular) planes (Figs. 30 and 31) have an adjustable metal sole; these are preferable to the wooden type, as they can be more accurately adjusted to the curve either concave or convex. Fig. 31 shows a later and better variety than Fig. 30. The sole of the plane is adjusted to the correct curvature in each case by the screw at the top.

Toothing Planes.—In making a glued

joint between two surfaces, or in veneering, the surfaces are "toothed" with a toothing plane. The toothing simply roughens the surfaces, thus enabling the glue to adhere better. The plane in shape

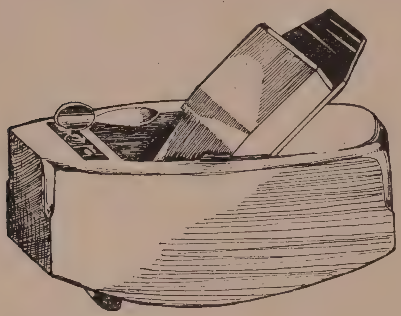


Fig. 29.—Wooden Compass Plane or "Round Sole"

is similar to a small smoothing plane, the difference is in the blade, which is upright, has no cap iron, and is grooved at the back. Fig. 32 shows the blade, which has a series of V-shaped grooves at the back. When the blade is sharpened, like an ordinary plane blade, the edge will consist of a series of small teeth something like the edge of a saw. When the plane is used the teeth scratch the wood and give a better surface for holding the glue. The plane is used after the manner of an ordinary smoothing plane, but is pushed over the wood in all directions, with and across the grain.

REBATE AND BULL-NOSE PLANES

Rebate planes (see Fig. 33) are usually

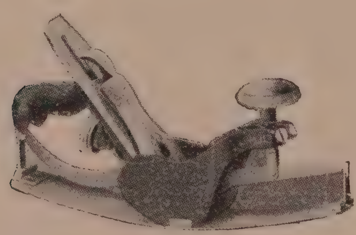


Fig. 30.—Stanley Adjustable Compass Plane

called "rabbit" planes in the workshop, and are used for making rebates, or "rabbits." Where a circular saw is available the rebate is cut out by using the saw with the table raised, and the rebate is then cleaned up with the rebate plane.

Rebate planes are made in various

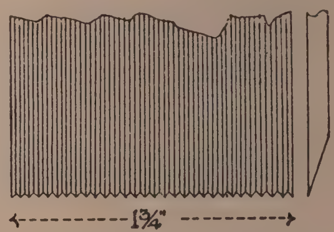


Fig. 32.—Blade of Toothing Plane

widths, ranging from $\frac{1}{4}$ in. to $1\frac{3}{4}$ in. A useful size is $1\frac{1}{4}$ in. The plane consists of three parts: body, blade, and wedge. There is no cap or back iron. The planes have either square or skew mouths. The latter type is the better—a skew mouth lets the shavings escape easily, thus preventing "choking," and a skew blade cuts better than a square one.

Rebate planes are not convenient tools for making rebates, but only for "cleaning up" rebates that have been cut by some other method. These methods will be described later, and include the circular saw, spindle, fillister, plough-cutting gauge.

Special rebate planes are used for some jobs. Suppose, for example, a "stopped" rebate had to be cut as in Fig. 33A. The best way to proceed would probably be to cut about 6 in. near the "stopped end" with the chisel and the rest with a

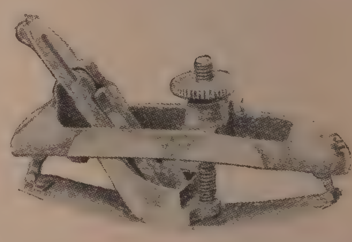


Fig. 31.—Victor Adjustable Compass Plane

plane. As, however, the rebate plane would not work close up to the stopped end, a special plane with its blade close

to the nose is used. This plane (*see* Fig. 34) is called a *bull-nose* plane, and is made of metal. It is 3 in. to 4 in. in length, and is very useful. It should form part of every woodworker's kit.

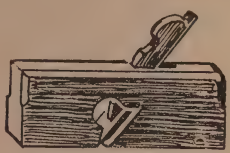


Fig. 33.—Rebate Plane

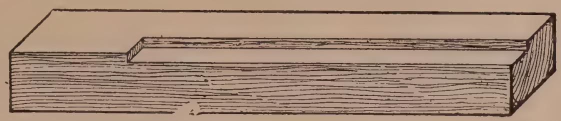


Fig. 33A.—Stopped Rebate

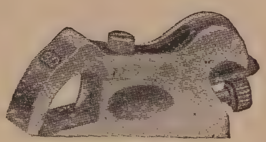


Fig. 34.—Bull-nose Plane

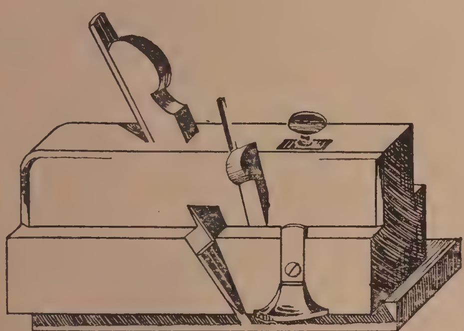


Fig. 35.—Moving Fillister

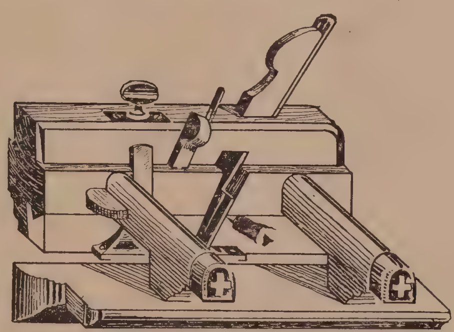


Fig. 36.—Sash Fillister

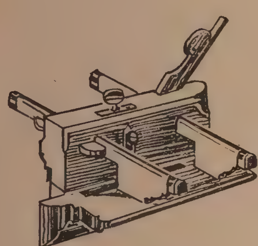


Fig. 37.—Plough

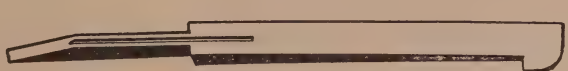


Fig. 38.—A Plough Iron

FILLISTERS AND PLOUGH

FILLISTERS are planes for making rebates. They consist essentially of a rebate plane with a movable fence, on the principle shown in Figs. 35 and 36. Two types are shown. The *Moving fillister* shown in Fig. 35 has a fence sliding on the sole of the plane, and the fence of the *Sash fillister* (Fig. 36) slides by means of stems through the body of the plane. The screw on the top of the plane enables it to be adjusted for any required depth of rebate. These planes are not much used, as a combination of the use of rebate plane and plough enables any rebate to be cut, and a plough is necessary for making grooves.

THE PLOUGH (Fig. 37) is used for making all sizes of grooves and rebates. The blade, or "bit" is fastened into the body of the plane by a wedge; a side fence works on stems after the manner of the sash fillister, and a screw on the top of the plane determines the depth of the groove or rebate. A set of six

or eight "bits" of various sizes is supplied with each plane (*see* Fig. 38). The method of using the plough is shown in Fig. 39. Take care to adjust the fence parallel to the "fin" of the plane.

JOINTING, MOULDING AND BEADING PLANES

Jointing or *matching* planes are made in pairs—one to cut the groove and the other the tongue (*see* Figs. 40 and 40A). A separate pair is required for each thickness of board. When making a tongued and grooved joint with match-

Fig. 39.—Using Plough

ing planes the joint should first be "made" (planed with the trying plane and adjusted to a fit), as the tonguing plane takes off an equal amount throughout the length of the board, and therefore if the pieces fit before being tongued and grooved they will fit afterwards.

Though moulding planes are not used in the workshop as much as formerly, a set of these planes is usually provided for "sticking" (moulding) short lengths, when it would not be worth while to "set up" a machine. The chief moulding planes are hollows and rounds, bead and ovolo planes.

A full set of hollows and rounds consist of 18 pairs, but about three "rounds" (*see* Fig. 42A) of various sizes are usually sufficient, except for very rare jobs. Hollows (Fig. 42) can be dispensed with if necessary, as the round portions of mouldings may be worked by the ordinary planes and then glass-papered to a finish.

Bead planes (Fig. 43) may be had in sizes to make beads from $\frac{1}{8}$ in. to 1 in. Planes for making small mouldings of

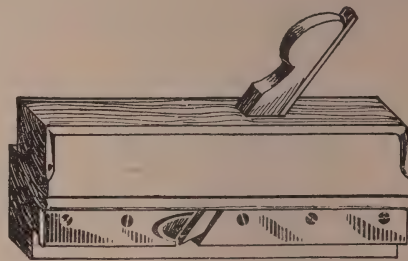


Fig. 40.—Grooving Plane

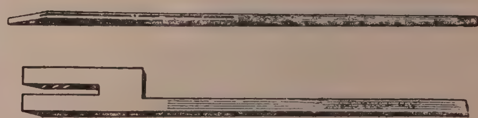


Fig. 41.—Blades for Matching Planes

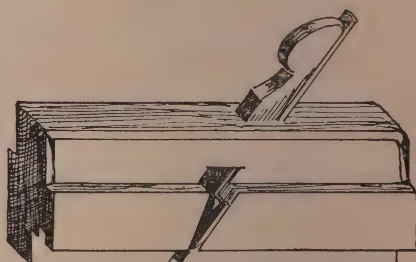


Fig. 40A.—Tonguing Plane

standard patterns as Fig. 44 may be obtained, but these mouldings and others can be made without special planes, as will be described later.

METAL PLANES

Two or three metal planes have already been described, but there are numerous other types, chiefly of the Stanley make.

An exceedingly useful metal plane is the block plane (Fig. 45). It is about

the size of a small smoothing plane, and can be used with one hand (*see* Fig. 46); it is thus very convenient for planing

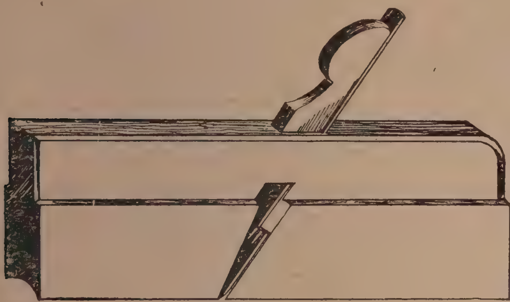


Fig. 42.—Hollow Plane

mitres as well as useful for all kinds of small work. The width of the mouth can be adjusted by means of the screw at the front. The blade is secured in position by means of the cap, propelled backwards and forwards by the screw at the back, and adjusted sideways by the lever at the back. The blade of the block

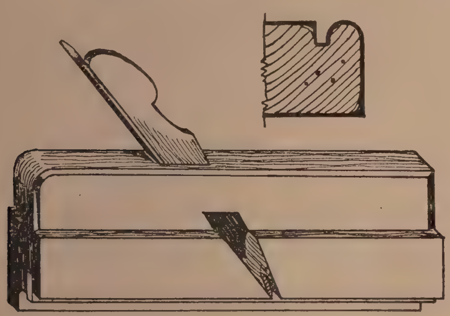


Fig. 43.—Bead Plane and the Beading Cut by it

plane is used with the bevel upwards, and the inclination of the blade is 20 deg. as against 45 deg. in ordinary planes.

Fig. 47 shows a block plane having the cutter at an even lower angle—12 deg. This angle enables the planes to be used with ease across the grain on hardwoods.

Large metal planes are not as largely used as was expected when they were introduced. The chief objection is that the metal "drags" on the wood, thus making the metal plane tiring to use. They are also more expensive and quite as liable to get out of order or get broken as, or even more than, wooden ones. The

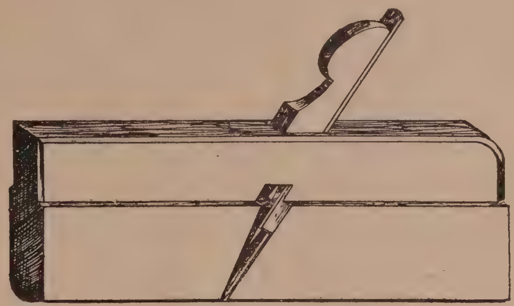


Fig. 42A.—Round Plane

average woodworker in this country nearly always has the three bench planes of wood, frequently an iron smoothing plane, usually a metal bull-nose and very often a block plane. Other metal planes are often met with, but though often very useful can hardly be said to belong to the average woodworker's equipment.

In order to avoid the excessive friction of the iron sole of metal planes, the sole is often corrugated as in Fig. 48. Another method of avoiding the "drag" of the metal is to have a plane with metal fittings and a wooden sole as in Fig. 49, which shows a Bailey jack plane and Fig. 50 a smoothing plane.

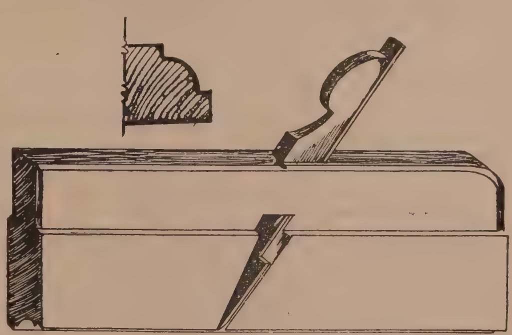


Fig. 44.—Ovolo Plane and Ovolo Moulding Cut by it

Fig. 51 shows a rebate plane with a square iron; the front part of the plane is movable and secured by the screw at

the top. This plane is very suitable for shooting the shoulders of tenon joints, and is sometimes called a shoulder plane.

Fig. 52 is a small metal plane about 4 in. long for planing the vertical sides of rebates; it has a reversible nosepiece, so that it will work closely up into corners when required.

Fig. 45.—Block Plane

Fig. 46.—Using Block Plane on Mitre

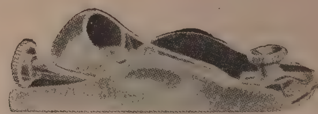


Fig. 47.—Low-Angle Block Plane for Hardwoods

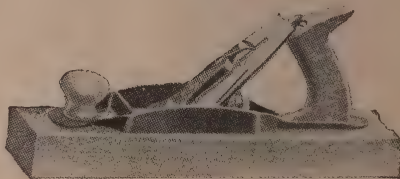


Fig. 49.—Metal Jack Plane with Wooden Sole

Fig. 50.—Metal Smoothing Plane with Wooden Sole

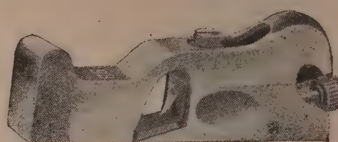


Fig. 51.—Shoulder Plane

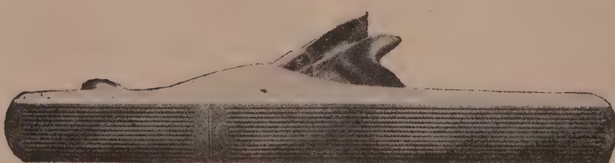


Fig. 48.—Metal Plane with Corrugated Sole

Fig. 52.—Side Rebate Plane

A Bailey adjustable jack plane is shown in Fig. 53. The illustrations give a plan and side elevation; a view of the seat for the blade, showing the screw for propelling the blade and the lever for lateral adjustment; the cap; the plane irons; and the iron, cap, and seat together. The method of adjusting the

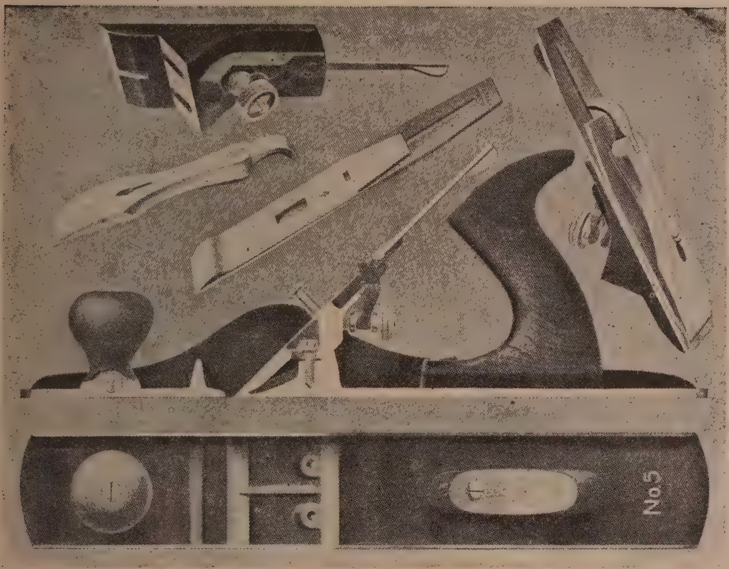


Fig. 53.—Bailey Jack Plane, showing Parts Separated

blade of metal plane is shown in Fig. 54.

Fig. 55 shows a cabinet-maker's edge plane; with the blade right at the end it can be worked close up into corners. A cabinet-maker's block plane with machined sides and suitable for fine work or with a shooting board is shown in Fig. 56.

Fig. 57 shows a block plane having a handle at the back so that the plane may be gripped and used comfortably.

Other special planes will be dealt with as they are required—notably the veneerer's and inlayer's toothing planes and router planes.

Fig. 56.—Cabinet-maker's Block Plane

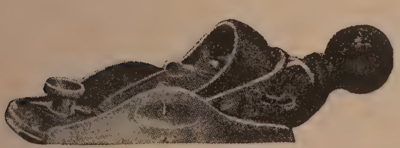


Fig. 57.—Handled Block Plane

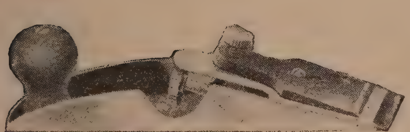


Fig. 55.—Edge Plane

Fig. 54.—Adjusting Blade of Block Plane

SPOKESHAVES AND ROUTERS

A spokeshave may be described as a small double-handled plane for planing curves. It is made of either metal or wood, both types being largely used.

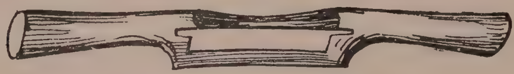


Fig. 58.—Wooden Spokeshave

Fig. 60.—Reeding Spokeshave

Fig. 59.—Metal Spokeshave with Adjustable Mouth

Fig. 61.—Hollow-handle Round-face Spokeshave

A wooden spokeshave is shown in Fig. 58. It consists of only two parts, the stock and the blade. The latter is sharpened with a finger-slip oilstone, as fully illustrated on another page, and is adjusted to take off the correct thickness of shaving by tapping the prongs, or the front, of the blade, with the hammer.

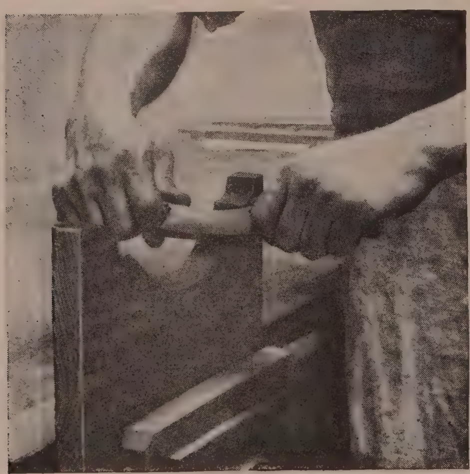


Fig. 62.—Using Spokeshave

The method of using the spokeshave is shown in Fig. 62. Always work "with the grain," as shown in Fig. 63, the arrows showing the directions in which the spokeshave should be pushed in order to avoid plucking up of the grain.

There are about four kinds of wooden spokeshaves: round faced for quick curves, flat faced for flat curves, brass-plated spokeshaves to prevent the mouth wearing, and spokeshaves with adjustable blades operated by thumb-screws.

Many varieties of metal spokeshaves may be obtained, with straight or raised handles, adjustable cutters, and types for quick curves (*see* Figs. 59 and 61).

A small spokeshave is usually better than a large one, as the small one will work both quick and large curves, whereas a large one is generally suitable only for big work.

A router is a tool after the manner of a spokeshave, but used for cutting trenches, reeds, and mouldings away from the edge of the timber or on curved work. Fig. 64 shows a router used for planing the bottom of trenches, say for shelving, stairs, etc. Special routers are mentioned on later pages.

Some routers have an adjustable fence so that grooves parallel to the edge of the timber can be cut.

Reeding and moulding tools are made in many varieties and consist usually of a two-handled body like a spokeshave,

a sliding fence, and a number of adjustable blades for cutting various forms of mouldings, beads, and reeds. A reeding tool without a fence, but capable of taking various sizes of reeding tools, is shown in Fig. 65. A reeding spokeshave is shown by Fig. 60.

Fig. 66 shows a reeding tool with two adjustable fences—one for straight and one for curved work. It is also suitable for light routing out. A tool that is sometimes used for secret nailing is shown in Fig. 67. A $\frac{1}{4}$-in. chisel when attached to the body turns up a small shaving as shown on a later page; when the nail is driven the shaving is glued and pressed back into position.

Fig. 68 shows an American tool for easily removing a corner from a long strip.

Fig. 63.—How Grain Influences Use of Spokeshave

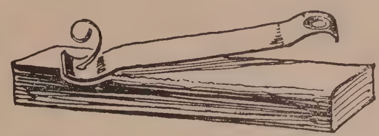


Fig. 68.—Light Cornering Tool

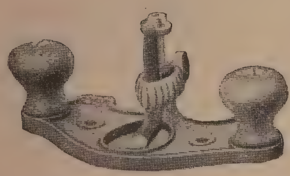


Fig. 64.—Router for Planing Bed of Trench, etc.

Fig. 66.—Reeding Tool with Two Adjustable Fences

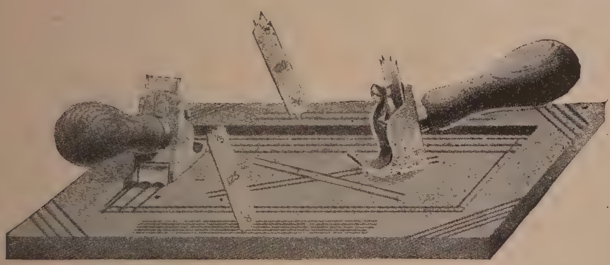


Fig. 65.—Reeding Tool without Fence

Fig. 67.—Tool for Turning up Shaving for Secret Nailing

Planing

THE object of planing is to make a piece of timber straight so that it does not twist, in order that it will fit into the required position, and also to make it smooth so that it may be painted, varnished, polished, etc.

Suppose a piece of timber, say about 3 ft. long, 4 in. wide, and 2 in. thick, is going to be used in the construction of a door or a piece of framing. Select the better side and place the timber on the bench and against the bench stop. First use the jack plane and take off "the rough," that is, make the surface fairly straight and smooth.

Figs. 1 and 2 show the method of using the jack plane. At the beginning of the stroke the left hand will have to press hard on the end of the plane, this pressure being released towards the end of the stroke. The right hand pushes the plane forward. If the plane takes off too much or too little—"too much iron" or "not enough iron"—the blade should be adjusted as described in the preceding chapter.


Fig. 1.


Fig. 2.

Figs. 1 and 2.—Using Jack Plane, Beginning and End of Movement

A common fault in planing is taking too much off the end near the bench stop. To avoid this try to take less off this end and more at the beginning of the stroke. Generally, take as little off as possible ; remember you can always plane a little more off, but you cannot put any on.

There is also a tendency to plane the surface round (convex in direction of length). With a piece of timber about 3 ft. long, it will be impossible to plane the surface hollow with a jack plane, except to a very slight extent depending on the projection of the blade. The best method of planing straight and avoiding planing round is to try to plane hollow. The surface can be tested for straightness with a straightedge or by sighting as in Fig. 40 (p. 35). The piece of timber shown in that photograph is being sighted for straightness of edge. Shut one eye when sighting and simply " spy " along the edge of the wood ; in this way the slightest irregularity can be detected. Sighting is a better and more usual method of testing than using a straightedge.

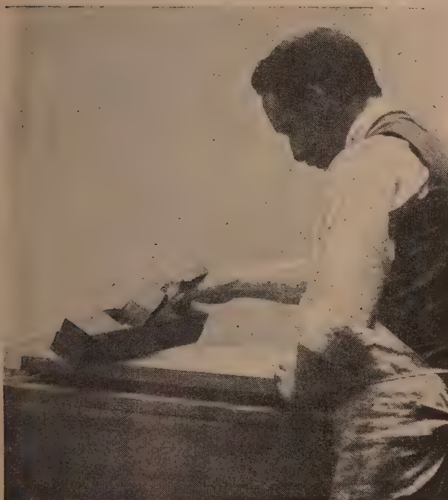


Fig. 3.

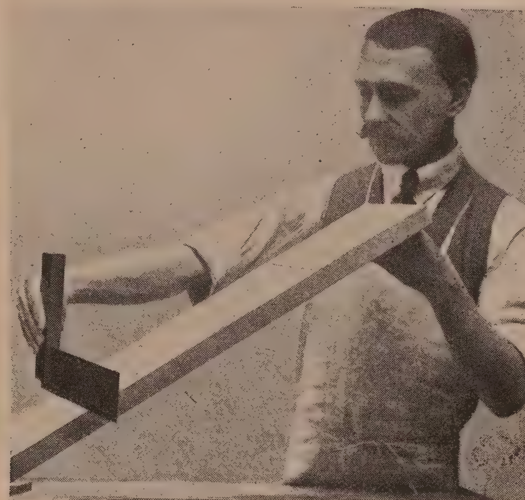


Fig. 4.

Figs. 3 and 4.—Testing across a Planed Surface

For straightness across the board the surface may be tested by holding the plane cornerwise as in Fig. 3 ; if the board is round or hollow light can be seen under the corner of the plane. A better method is to use the blade of the square as shown in Fig. 4.

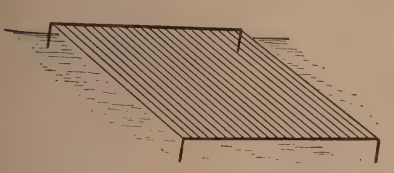


Fig. 5.—Plane Surface

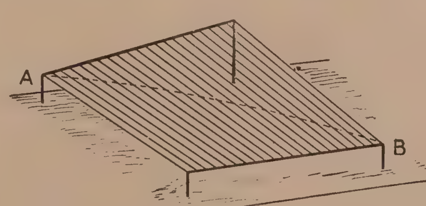


Fig. 6.—Twisted Surface

Twist.—Besides being straight the timber should be *out of twist*—that is, the surface should be a plane, or flat, surface. Beginners usually have some

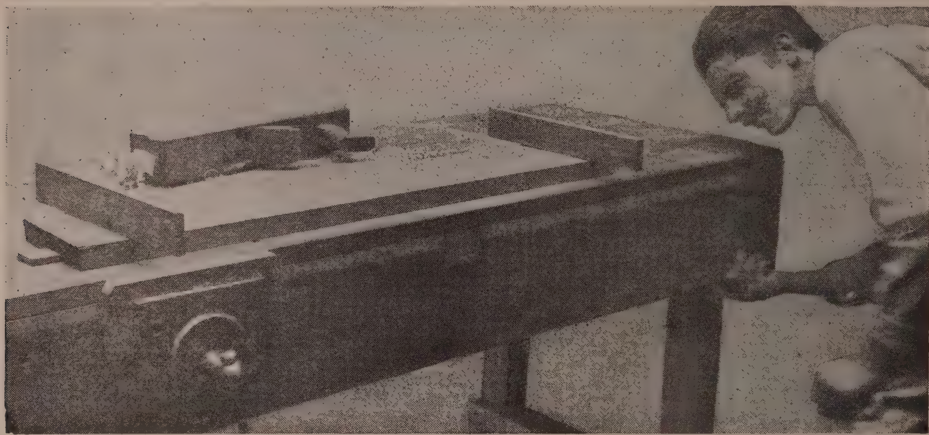


Fig. 7.—Using Winding Strips

little difficulty in understanding what a plane surface (or a surface out of twist) really means. Suppose we have two rods perfectly level (as tested with a spirit level); *see* Fig. 5. Now suppose strings were connected, close together, from rod to rod: a plane surface would be thus formed. Consider now that only one of these rods was level and the other sloping and were connected by strings; we should thus get a twisted surface as in Fig. 6. Note that the strings and rods are *straight*—that is, all the edges

Fig. 8.

Fig. 9.

Figs. 8 and 9.—Winding Strips on Plane and Twisted Surfaces respectively

of the surface are straight yet the surface itself is twisted.

A surface is tested for twisting by using a pair of winding strips as in Fig. 7. These strips may be about 18 in. long by 2 in. wide by $\frac{1}{2}$ in. thick; the upper parts of the strips are usually bevelled to make the top edges thinner. If the surface twists, the winding strips will appear as in Fig. 9. It will be seen that the winding strips exaggerate the twist and thus make it easy to detect. The amount of twist may easily be estimated. Suppose that the right-hand end only of the back strip projects above the front one $\frac{1}{2}$ in. (as in Fig. 9) and that the width of the wood is 4 in. and the length of the winding strips 16 in. The proportion of length of winding strips to width of surface is thus 4, and the amount of twist will therefore have been magnified four times; the amount of twist of the surface is therefore $\frac{1}{8}$ in. Fig. 9 shows the surface with the amount of twist exaggerated for clearness.

To take the surface out of twist it will

obviously be necessary to plane away the two thin wedge-shaped portions shown.

The workman does not calculate the amount of twist as given above, but guesses the amount to be planed off, then tests again, and so on until the surface is correct; but an understanding of the above theory will enable a more accurate guess to be made. It is not often that an experienced man needs to use the winding strips more than twice on the same surface.

It has been shown that a surface may twist though the edges are straight (*see* Fig. 6), but a twisted surface must be curved somewhere. For example, a line as A B (Fig. 6) passing on the surface from corner to corner will be convex. If a straightedge could be put in all directions on a surface so that it touched the surface at all points, then that surface would be out of twist. As, however, timber is usually very narrow in proportion to its length, any method of testing for twist with a straightedge is usually not reliable. (The surfaces of stonework are often

Fig. 10.—Observing whether a Small Surface is Twisted

Fig. 11.—Face and Edge Marks

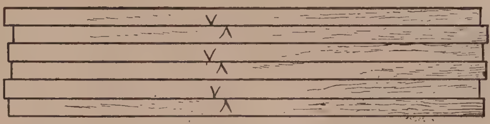


Fig. 12.—Edge Marks, showing how Pieces are arranged in Pairs when Setting Out

Fig. 13.

Fig. 14.

Figs. 13 and 14.—Edge Planing, with and without using Vice. Note Position of Fingers

taken out of twist with a straightedge alone, because stone surfaces are usually broader in proportion to length than timber surfaces.)

The jack and trying planes are often

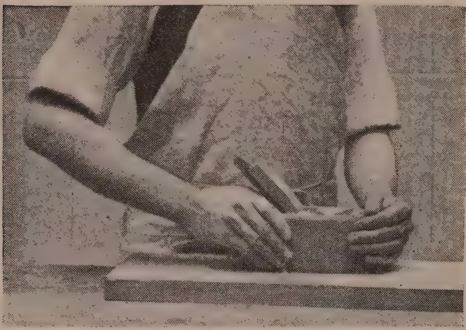


Fig. 15.—Using Smoothing Plane

used instead of winding strips ; the planes are laid on their sides with the jack plane nearest the eye.

Another method of testing for twist, suitable for small stuff, is shown in Fig. 10. This method, which simply consists in holding the surface in a suitable position and looking at it, requires a little practice and care to use successfully.

After the "rough" has been taken off with the jack plane the trying plane is used for straightening and taking out of twist. When the latter has been accomplished the surface is "face marked" as shown in Figs. 11 and 12. The edge is now ready for planing.

Squaring the Edge.—Select the better edge, and place the timber, if it is thin, in the vice, or, if it is thick enough to stand up whilst planing, put it on the bench (*see* Figs. 13 and 14). Hold the plane as shown with the tips of the fingers of the left hand gliding along the side of the wood, so that the sole of the plane can be held steadily at right angles to the surface already planed. Test for straightness as in Fig. 40 (p. 35) and for squareness to the "face" by using a square. Hold the square and timber towards the light so that any light may be seen between the edge of the timber and the blade of the square. Either glide the square along the timber or test at intervals of about 6 in. If not square, plane the prominent parts ; if correct, mark a "face edge mark" as in Fig. 12. This mark is usually a **V** pointing to the face side.

Planing to Correct Width and Thickness.—The third side, or rather the second edge, has now to be planed. Set the marking gauge to the required width of the piece of wood and gauge *on the face side, from the face edge.* Plane the third side (or second edge) to the gauge line ; this will make the third side straight and the wood parallel. Test the edge with the square from the face side.

We now come to the last side or back. Set the gauge to the desired thickness and gauge both edges from the face side. Plane to the gauge lines. The timber is now said to be "trued up," that is, it is (1) straight, (2) out of twist, (3) square, and (4) the desired size.

In making any article, the pieces for the framework are first "trued up"; they are then "set out" for mortising, tenoning, moulding, etc., after which operations the framework is fastened together and finished off. This finishing varies with the class of work, rough work being simply planed ; painted work being usually planed and glasspapered ; and

Fig. 16.—Using Metal Smoothing Plane

polished hardwood being planed, scraped, and glasspapered.

Thin stuff is not planed out of twist as it can be easily bent to the correct

position; panels and similar stuff are simply planed smooth and to even thickness.

A surface is planed smooth by using the smoothing plane; the method of holding and using is shown in Fig. 15. In order to produce a smooth surface having no rough or "plucked up" grain, the two main points to be observed are to set the plane fine and to plane "with the grain." Remember that to set the plane "fine" the iron should project as little beyond the sole as is consistent with removing a suitable shaving, and the set back of the cap iron should be as little as convenient. The blade should be kept sharp.

Fig. 16 shows a metal smoothing plane in use.

As the smoothness of the finished surface depends largely on planing with the grain, and as this is not understood thoroughly even by the majority of experienced workmen, the nature and cause of the grain of timber will now be explained.

Planing and the Grain of Timber.—On examining the section of a tree trunk as in Fig. 17 it is found to consist of annual rings. The tree is therefore made up, as it were, of a number of cylinders encasing each other. Of course, these cylinders are not straight or truly circular in section, but for the purposes of explanation let it be supposed that they are, as in Fig. 18. If a slice is cut off the trunk as Fig. 19, the grain of the surface will simply be a number of parallel straight lines. Now cut the trunk obliquely, and the section will be a number of ellipses, as in Fig. 20.

The surface in Fig. 19 may be planed in either direction, but the cut surface in Fig. 20 must be planed in the direction of the arrow or it will "pluck up"; planing in the direction of the arrow is called planing "with the grain," and planing in the reverse direction is "against the grain." If the surface is planed against the grain the blade of the plane tends to dig in the wood at the corners marked A, and a rough surface results.

Consider now an actual tree trunk: Fig. 21 shows the elevation of the trunk and Fig. 22 the plan of the end. Saw

Fig. 17.—Section of Tree

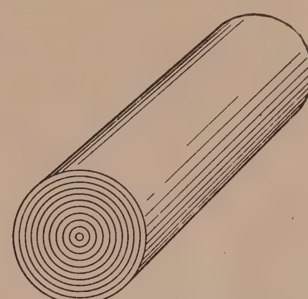


Fig. 18.—Imaginary Tree

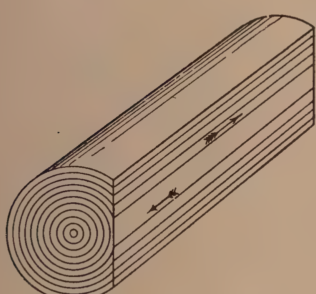


Fig. 19.—Obtaining Straight Grain

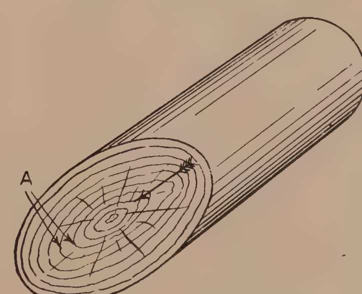


Fig. 20.—Tree Trunk Cut Obliquely

the trunk on the line A B. On taking away the portion cut cff the view of the cut surface of the trunk will be as in Fig. 23. The direction in which the wood should be planed is shown by the arrows.

A rectangular piece of wood is shown in Fig. 24, the arrows showing the direction for correct planing. Note that if the surface were planed in the wrong direction there would be a tendency to pluck out the small piece A.

The directions for planing do not depend on the shape of the grain lines, but on how the grain rises to the surface of the wood; for example, in Figs. 25 and 26 the surfaces of the two boards are very much alike, but the grain on the edges show that the graining rises to the surface in a different manner. The arrows show the direction for planing. It is, however, not necessary to observe the edge to tell the correct direction for planing; this can be detected by looking at the grain on the surface and seeing how it rises to the surface.

The average woodworker spends a large proportion of his time in planing, and it is well worth while to understand the above theory of graining, as it will lead to better and quicker work But even the experienced craftsman is sometimes very hazy about grain; his usual method is to plane the timber regardless of grain, and then plane the plucked-up parts in the reverse direction, if necessary. This method may be excused for painted work; but for hardwood—say mahogany—if the grain is plucked up badly—and this is commonly done—much work with the plane and scraper is necessary before it is remedied. It is obviously a great advantage in planing curly-grained stuff to know, before the


Fig. 21.

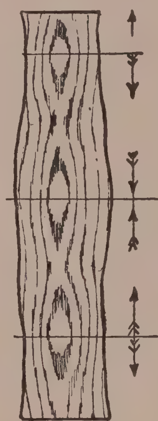


Fig. 23.—Grain of Sawn Trunk

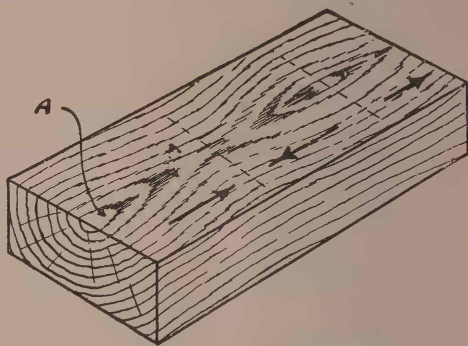


Fig. 24.—Effect of Grain on Direction of Planing

Fig. 22.

Figs. 21 and 22.—Elevation and Plan of Tree Trunk

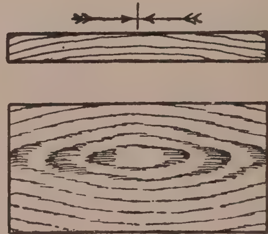


Fig. 25.

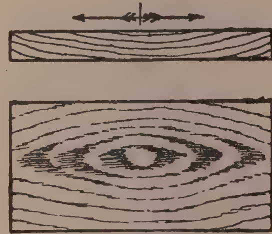


Fig. 26.

Figs. 25 and 26.—Wood Grain

plane is put on the wood, which way the grain goes. The method of testing it

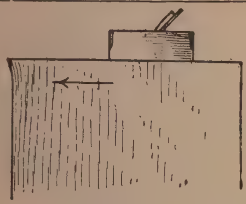


Fig. 27.

Fig. 28.

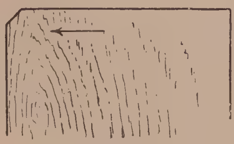


Fig. 29.

Figs. 27 to 30.—Planing End Grain

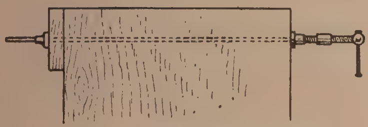


Fig. 30.

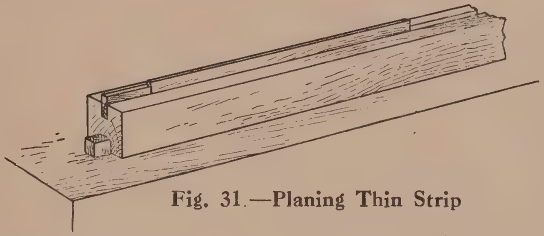


Fig. 31.—Planing Thin Strip

with the plane and the subsequent working up is wasteful of time, labour, and material.

Planing End Grain.—It might be said that there is one wrong method of planing end grain, and three correct ones, each of the latter being specially suitable under given circumstances.

If a piece of wood is planed on the end by pushing the plane along the *end* as if it were the *edge* of a board a small piece will probably be knocked off at the end, as shown in Fig. 27. The usual method is to plane from each end as in Fig. 28. Another way is to take a small corner off the far end with the chisel and then plane straight through as shown (*see* Fig. 29). The small bevel prevents any breaking. Of course, this method cannot be used where the end must be left perfectly square. Fig. 30 shows a further method, which consists in fastening (probably with a cramp) a bit of wood at the far end to prevent splitting and then planing straight through.

Planing Thin Strips and Panels.—When planing thin strips, particularly on the edge, a piece of timber with a groove in it to hold the strip is often used (*see* Fig. 31); the strip is thus kept in a suitable position and can be planed with greater ease.

Fig. 32.—Testing Thickness of Panel with a "Mullet"

Panels are tested for thickness by means of a " mullet " or " mulleting piece " (*see* Fig. 32). This is a small piece of wood that is grooved at the same time as the framework, and therefore if the panels fit the mullet they will fit into their proper grooves.

In ordinary mechanical language, the " mullet " is a notch gauge.

In planing panels and suchlike stuff the object is to make them smooth and of even thickness so that they will fit neatly into their grooves. As the top of the bench is often rough and uneven, a " panel board " is sometimes used (*see* Fig. 33). This is merely a wide board about 4 ft. or so long, with a butting strip to act as a stop at one end. This strip is better than the bench stop when planing wide stuff.

In planing panels, and smoothing up generally, some workmen begin planing near the bench stop and work backwards ; they argue that every time the plane is put down and a shaving begun a slight mark is made on the wood, and that in planing from the bench stop and working backwards these marks are avoided. This generally is not a matter of much consequence, but on the whole this method of beginning at the bench stop end may be recommended, but for " smoothing " only.

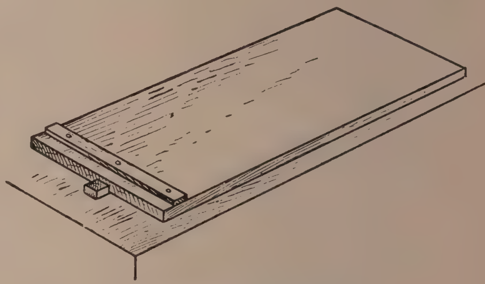


Fig. 33.—A Panel Board

The use of special planes will be dealt with later in connection with the processes for which they are required.

The Scraper

THE ordinary scraper (Fig. 1) consists simply of a piece of hard steel about 4 in. long and 3 in. wide and about $\frac{1}{16}$ in. thick. It may be purchased from the tool dealers or may be made from an old handsaw blade. Usually it is bought.

A scraper when properly sharpened does not merely "scrape" the surface of the timber, but planes it—something (but not exactly) after the manner of an ordinary plane. Fig. 2 shows the edge of a scraper magnified, with the turned-up or "burred" cutting edges exaggerated. When using the scraper the turned-up sharp edge is pressed into the surface of the timber, and when the scraper is pushed along a thin shaving is removed.

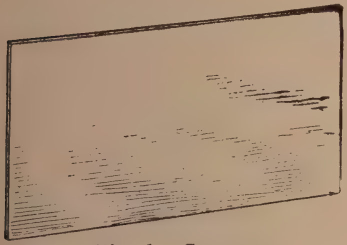


Fig. 1.—Scraper

Fig. 2.—Action of Scraper

Fig. 3.—Action of Glass Scraper

A piece of glass is often used as a scraper. The edges of the glass are, of course, not turned up, but are extremely sharp and hard, and "bite" into the surface of the wood (*see* Fig. 3). Glass is not used as a regular scraper, but is very handy for finishing hammer shafts and suchlike work when a proper scraper is not to hand.

Sharpening the Scraper.—As the scraper is not an amateur's tool and the sharpening demands considerable skill, this process will be described very fully. The object to be attained is to make the edge of the scraper straight, smooth, and square, and with just the long corners of the edges turned up slightly. By "corners," in this connection, is meant not the two *ends*, but the two square arrises formed by the two faces of the steel meeting the square edge.

If the scraper is in very bad condition its edge must first be straightened and squared with a file (Fig. 4); a saw file is generally used, and is worked along the scraper so that the edge is kept straight. Care should be taken not to file the edge hollow, as it would not then cut in the middle; on the other hand, a slight convexity of edge does not much matter, and is, in fact, preferred by some woodworkers as it enables the scraper

Fig. 4.—Filing Edge of Scraper Square

Fig. 7.—Removing Burr on Oilstone

to work easily in parts that are slightly hollow, and the outside corners do not then tend to "dig in."

The edge of the scraper is now rubbed on the oilstone as in Fig. 5; this tends to make the face of the stone hollow. Consequently the edge of the stone is often used as in Fig. 6. This latter method is recommended, as the edge of an old stone is usually straighter than the face. After about half a dozen rubs the scraper is next rubbed flat on the surface to remove any "burr" from the corners (*see* Fig. 7).

Now lay the scraper flat on the edge of the bench (as Fig. 8) and hold it firmly with the left hand. Take a piece of hard steel, such as a chisel or a gouge—a $\frac{3}{8}$-in. or $\frac{1}{2}$-in. gouge is very suitable—and, pressing the steel flat on the side of the scraper, rub it along the scraper about a dozen times. Turn the scraper over and repeat on the other side. A special scraper sharpener as Fig. 7A, is sometimes used, but is hardly necessary.

Fig. 7A.—Scraper Sharpener

Next hold the scraper upright on the bench as in Fig. 9; grasp it firmly and press it heavily on the bench; to avoid hurting the hand the top edge is often covered with the apron. Hold the sharpener tightly against the edge, at the bottom, with an angle of about 80 deg. between the sharpener and the scraper,

Fig. 5

Fig. 6

Figs. 5 and 6.—Rubbing Scraper on Oilstone

Fig. 8.

Fig. 9.

Fig. 8 (*above*).—Rubbing Side of Scraper with Tool

Fig. 10.—Another Way of Holding Scraper when Forming the Burr

Fig. 9 (*above*).—Forming the Cutting Burr on the Scraper

Fig. 11.

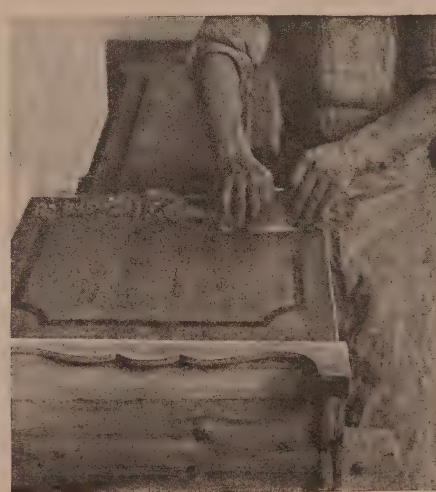


Fig. 12.

Figs. 11 and 12.—Two Methods of using Scraper

and bring the sharpener sharply upwards. Whilst doing this it is better to give a slight dragging action by pulling the hand away from the face of the scraper as the sharpener is pulled up-

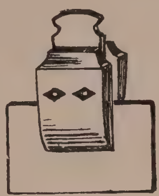


Fig. 13.—Handled Scraper

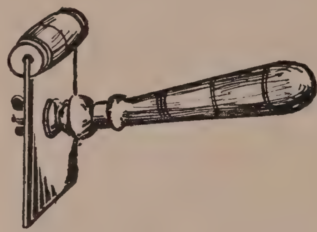


Fig. 15.—Scraper with Ball-jointed Handle

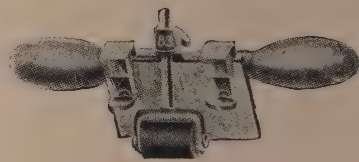


Fig. 17.—Double-handled Scraper with Roller

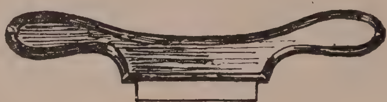


Fig. 14.—Scraper with Double-ended Handle

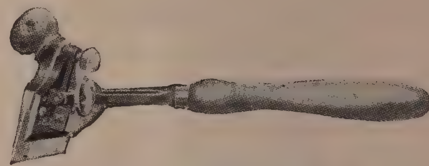


Fig. 16.—Another Adjustable Scraper

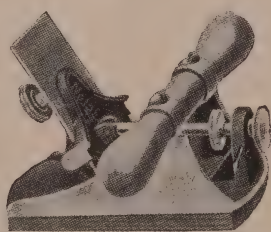


Fig. 18.—Double-handled Scraper Plane

Fig. 20.

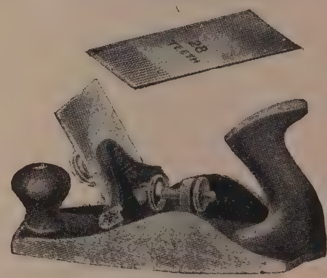


Fig. 19.—Single-handled Scraper Plane

Fig. 21.

Figs. 20 and 21.—Scrapers for Mouldings.

wards. This tends to form a better burr on the corner. Turn the scraper over and repeat the process on the other corner. Fig. 10 shows another method of holding the scraper when burring the edge.

Usually, the two long edges are sharpened, thus providing four distinct cutting corners.

Using the Scraper.—Sharpening a scraper is a more difficult proceeding than using it ; the latter is quite simple. The usual method of holding is shown in Fig. 11. Grasp the scraper as shown, with the fingers round the front and the thumbs at the back. Incline the scraper at an angle of about 60 deg. and push it forward (away from the body), when a thin shaving will be removed. Another method of holding and using is shown in Fig. 12.

Sometimes in scraping over a knot or other rough place it is an advantage to bend the scraper a little when using so that the edge will work into any slightly hollow part of the wood.

After using for a short time the scraper tends, through friction, to become hot and uncomfortable to hold. To overcome this discomfort the scraper is often

fitted into a handle. Fig. 13 shows a handle fixed by means of a wedge at the top, and Fig. 14 shows a double-ended handle for grasping with both hands; the underside of the handle has a groove to receive the scraper.

Figs. 15 to 19 illustrate various Stanley scrapers and scraper planes. The handle in Fig. 15 is fitted with a ball joint so that it can be held at any angle to the blade; the top edge has a padding of wood, so that pressure can be applied downwards with the left hand without discomfort. Fig. 16 shows another form of adjustable scraper, and Fig. 17 illustrates a double-handled scraper with a roller at the back, which helps to relieve the strain on the wrists of the workman. A double-handled scraper plane is shown at Fig. 18, and a single-handed scraper plane at Fig. 19. Either of these adjustable tools can also be used as a toothing plane by inserting the blade shown above, Fig. 19.

For scraping mouldings a small curved scraper as in Fig. 20 or Fig. 21 is sometimes used, though mouldings are cleaned up chiefly by means of glasspaper, as will be described later.

It has been mentioned early in this chapter that scrapers may be made from old saw blades, but it should be noted that rusted and pitted steel is unsuitable, it being impossible to turn up a good cutting burr on metal spoilt by rust. The temper of a high-quality saw blade is just about right for the scraper since it allows of just—and only just—being filed, while at the same time it is sufficiently elastic to "give" very slightly in use. If the steel is hardened too much the result will be that, although it may be possible to turn up a burr, this will have no lasting qualities because of its brittleness, and resetting and resharpening will soon be necessary, while, of course, the quality of the work will also suffer. Many woodworkers have not seen a scraper correctly sharpened and used. It is very often used inefficiently even by craftsmen. Made of the right material, correctly sharpened and skilfully used, it becomes a true cutting tool capable of removing a long series of true shavings—not scrapings.

Timber: Its Growth and Properties

Introductory. — It is important for every craftsman to be acquainted with the natural characteristics of the raw material with which he works. It may, in fact, be doubted whether the highest craftsmanship can ever be attained without such knowledge. In so far as it is thorough, such practical knowledge will be scientific, although the craftsman may be but little acquainted with the technicalities or terminology of any science, and although he may only consider his material from a more restricted standpoint than the man of science may do.

As woods are never as homogeneous as metal may be, and vary in structure (and in the other characters dependent on it) not only according to the kind of species of tree from which they are derived, but also according to the situation in which, and the rate at which, it was grown, the age of the tree, and whether the wood be taken from the heart or from the exterior, from the butt end or from the top of the stem, it must always be more difficult to gain an accurate knowledge of this material than to measure the properties of a mass of iron, steel, brass or copper.

The worker in wood is not directly concerned with the botanical characters of trees, nor with the physiological uses of the wood to the living plant. He has, as a rule, neither flowers, leaves, nor bark to aid him in identifying the wood he is using; but deals only with "converted" material. So, too, the defects from which his material suffers, the insects that burrow into it, and the fungi which may bring about its decay, are not, for the most part, those that attack the living tree.

At the same time, the physical and mechanical characteristics of wood which determine its fitness for the various purposes of the craftsman are so dependent upon its mode of growth and its minute anatomical structure, that it is impossible to gauge those properties without reference to the natural history of the tree. It may be said in general terms that woods derive their utility from being soft enough to be cut, sawn or cleaved by ordinary hand tools, while stable or strong enough, and durable enough, to retain the form into which they are cut, under considerable strain, and for a long period without decay.

Sources of Wood.—The great class of flowering and fruit-bearing plants which includes grasses, lilies, orchids, screw-pines and palms, contains some plants with woody stems. Here, however, the bulk of the stem is soft, or, as in bamboos and other grasses, hollow; while the wood is in isolated strands crowded together towards the outside of the usually unbranched trunk. In the tropics palm-stems are often split for flooring or rough building, in spite of their splintery texture and very unequal wearing.

With this unimportant exception, woods are the produce either of the natural order *Coniferæ*, which includes pines, spruces, firs, larches, cedars, junipers, yews, etc., or of the great class *Dicotyle-*

Photo: G. Clarke Nuttall

Fig. 1.—The Oak in Summer

dons. Though they agree, as we shall see, in the main principles of the growth of their stems, these two groups differ in several marked and generally recognized characters. The Coniferæ, or conifers, as they are styled in English, are so called because their seeds are not enclosed in a fruit, but are, as a rule, on the inner surfaces of a series of scales overlapping one another to form a cone. Fig. 6, on page 121, shows the cones of some of the best known conifer trees. Conifers have mostly very narrow, pointed, rigid leaves, and are, therefore, often styled "needle-leaved trees"; and, with the exception of the Yews, they have wood generally rich in resin. Fig. 5 shows the needle-shaped leaves of several conifer trees. Generally of rapid growth and of a structure which, compared to that of Dicotyledons, is simple, uniform, and of an even grain which renders it easy to work, their wood is commonly known as "soft" or "resinous." As a matter of fact, many Dicotyledons (or "broad-leafed" trees) grow as fast as conifers, and others, such as Willows, Poplars, and Horse-chestnut, have woods that are softer than some of the group technically known as "soft woods."

Broad-leafed trees are known as "hardwoods." They have their seeds enclosed in true fruits; their leaves are generally broad, with a network of branching veins; and their wood is of a more complex structure and, therefore, often more difficult to work than that of the conifers. Fig. 10 shows the leaves of a number of hardwood or broad-leafed trees.

Origin of Wood.—It may fairly be

Photo: G. Clarke Nuttall

Fig. 2.—The Oak in Winter

said that most of the properties for which we value wood are those which render it of use to the living tree. Its strength, combined with some elasticity and toughness, or power to resist various transverse strains, enables the living tree to support the weight of its own branches and foliage and to yield to the wind without snapping or being torn asunder. At the same time it is important to bear in mind, that in the living tree, wood is only formed gradually, and in its early stages of development performs functions other than these mechanical resistances to strain.

All the higher plants when young are alike built up of cells, minute sacs of cellulose, filled with protoplasm and combined into tisuses.

In the young stems and branches of trees the cells become elongated in the direction of growth, in a vertical direction, that is to say, in the stem, while still thin-walled and soft and retaining their protoplasmic contents. Those at or near the surface undergo a thickening of their walls with a substance that renders them highly elastic and impermeable, lose their protoplasm, and become cork. Those at the centre of the stem or branch merely lose their protoplasm, thus becoming physiologically dead, and are known as pith. This tissue may remain intact for some years, as in the Elder; it may become ruptured into a succession of transverse discs with intervening spaces, as in the shoots of the Walnut; it may dry up and be torn into longitudinal shreds, as in the withered winter stalks of Burdocks or Hemlock; or it may be recognizable in the centre of an old but sound stem, such as that of an Oak, 100 or 200 years old, as a line of loose dried powdery cells. It is then important, not merely as indicating that a plank is derived from the very centre of growth, but also that no decay has set in at that centre.

Between the young cork and the pith a ring of strands of cellular tissue undergo marked changes. The cells, or "elements" of which they are made up, are much elongated, so that they appear smaller than the other cells of the stem, when it is cut across, and have collectively a greyish effect amid the white tissue. In a cross-section of a stem—one, that is, cut horizontally or at right angles to the general direction of growth—these "bundles," as they are called, appear more or less wedge-shaped, with their broader ends towards the outside of the stem. The walls of some of the outermost and of the innermost elements in each bundle become thickened with ligno-cellulose, and they gradually lose their protoplasm. This change extends outwards and inwards to all the elements in the bundle except those forming a narrow line parallel with the circumference of the stem. This layer retains its protoplasm and persists throughout the life of the stem as a growing or "cambium" layer, its cells undergoing repeated tangential division — division, that is, parallel to the surface of the stem—and sometimes also transverse division.

The elements of the tissue between the bundles elongate radially, that is, from the pith outwards, and constitute what are known as the "medullary," or "pith," rays, familiar to the worker in ornamental woods as "mirrors," "silver-grain," or "figure." As the bundles do not develop in a perfectly straight course up the stem, this ray tissue is so divided up that it appears on the outer surface of the cylinder of wood when a tree is barked as a series of more or less elliptical patches with their longer axes vertical. It is when a stem is "quarter-sawn," that is, cut radially, that it is most conspicuous, appearing as a series of more or less interrupted lines or patches extending along the surface of the plank in the direction of the radius of the stem, as in what is termed "wainscot oak." These markings are also called the "silver grain."

In the second season's growth the active division of the cambium cells extends laterally in both directions across the pith-rays between the bundles, so that for the first time the central portion of the stem becomes thoroughly enveloped by a complete sheath of this soft protoplasmic tissue.

It is at this stage that we can first readily peel a twig, tearing as we do so through these cambium cells. The portion of the

stem from the cambium inwards to the pith is known collectively as the "wood." The outer surface of the wood of the peeled twig is sticky with the protoplasm of the torn cambium cells, and it is during the season of vigorous growth, "when the sap is up," that it is most easy to "bark" or "rind" logs.

Growth-rings.—During this second season of growth and each succeeding season, the cambium layer by the division of its cells adds new wood to the outside of the wood-cylinder, at the same time adding also to the pith-rays and, to a less amount, to the inner bark. It is to this method of growth by additions at the outside that the stems of conifers and broad-leafed trees owe the name "exogenous." In temperate latitudes, like our own, most broad-leaved trees shed their leaves in autumn; and, like the conifers, go through a period of rest, when, at the lower temperature, neither roots nor leaves take in much food; and the wood formed is thus distinctly divided up by pauses into annual rings.

In equatorial forests, where nearly all trees are evergreen and there is but little contrast of seasons, this division of each year's growth is less distinct, so that the term "growth-rings" is preferable for general application to "annual rings." These rings vary very much in width, even in different parts of the same tree; and they tell us so much about the nature and life-history of the tree that the first thing to do in examining a piece of wood, whether to identify the species to which it belongs or to study the history of its development, is to secure a cross-section showing them, cutting it smooth with a plane or a sharp knife. In young trees, grown in the open, and what the forester terms "thrifty," the growth-ring is widest near the butt, stump or base; but in older trees, especially when growing close together, it is narrowest at the base and at the apex, and widest towards the upper part of the tree. This is mainly dependent upon the area of the leaf-surfaces that contribute the food-supply by which the wood in any particular part of the stem is formed.

It must be remembered also that as the girth of the stem increases with age, the addition of a narrower ring of wood

Photo: G. Clarke Nuttall

Fig. 3.—The Pine

round the increased circumference may represent the formation of much more wood than a wider ring of less circumference.

In our ordinary forest trees, whether conifers or hard woods, rings half an inch wide seldom occur except near the centre, that is, representing the growth of the first few years, and in very thrifty specimens. The central twenty rings—that is, the growth of the first twenty years—in Pitch Pine may each be one-sixth to one-eighth of an inch wide; while the same number of rings at the outside of a large tree may only average a thirtieth of an

inch each. These figures indicate, of course, an increase of diameter of the tree by a third, a quarter or a fifteenth of an inch in the year respectively. Twelve rings to the inch represents, in our latitudes, good thrifty growth; but slow-growing trees may not show half this; and stunted pines may have two hundred rings to the inch.

An exceptionally narrow ring in the series, or the defect known as "cup-shake," when the rings of two successive years do not cohere, may mark a season when the young leaves were stripped from the tree by caterpillars; whilst the sudden appearance of an increased width of ring often marks the admission of more light and air to the tree by the clearing away of some of its neighbours. The rings are seldom exactly circular, the centre of growth being, that is to say, excentric. This is especially the case with trees at the margin of a wood or where one side is in any way more exposed and thus forms less wood than the other. In the wood of horizontal branches more is formed on the lower side, under the influence of gravitation, so that the centre of growth, the pith, that is, is generally much nearer the upper surface of the branch and the rings are very elliptical.

Soft Wood.—So far a general description has been given of the stem of a tree, which is true alike of those of conifers and of those of broad-leaved trees. When, however, we come to look into the elements of which the wood is built up, we have to distinguish between the relatively simple wood of the former and the complex and varied woods of the latter.

The woods of the Coniferæ are mainly made up of elements known as tracheids, interrupted only by resin-ducts and by pith-rays so narrow as not to be recognizable by the naked eye. The tracheids are elongated, spindle-shaped, fibre-like elements, polygonal in transverse section and from a twentieth to a fifth of an inch in length, fifty to one hundred times their width. On their radial walls, that is on those parallel with a radius of the stem, and occasionally on other sides, they are marked by structures known as bordered pits, and they are themselves arranged in radial rows. Each of these rows is, in fact, the result of the repeated divisions of a single cambium cell. Their walls are thickened, the pits being merely spots at which no thickening of the original cell-wall has taken place. These pits allow of the more ready permeation of water from one element to another, the thickening being absent in the two contiguous elements on both sides of the cell-wall. A uniform absence of thickening at the same spot in successive thickening-layers forms a canal which, when seen in profile, will appear under the microscope as a more or less circular bright spot; but where each successive thickening-layer projects a little more over the unthickened spot a funnel-shaped canal is formed on each side of the wall, and the appearance in profile is of a bright spot surrounded by a less bright border. The first case is known as a simple pit, the second as a bordered ono. The appearance of vertical rows of these double circles on the walls of the constituent tracheids enables us instantaneously to recognize a transparent sliver of wood when placed under a low power of the microscope—such, for instance, as a slice shaved from a lucifer match, in the direction of the grain—as being coniferous.

Early and Late Wood.—A cross-section of pine or spruce shows each growth-ring to consist of two parts, an inner, softer, light-coloured portion, and an outer, firmer, darker-coloured portion. The former is styled the spring, or preferably the early, wood; the latter, the summer, autumn, or late wood. The distinctness of colour of these two parts of the ring varies much in different species; and obviously, as the darker late wood is the stronger, the greater the proportion it bears to the whole, the heavier, harder, and stronger will be the wood.

This higher proportion of late wood occurs near the base of the tree, and after the first few years. In pitchpine for instance, it is stated to form often 45 per cent. of the wood at the butt and only 24 per cent. at the top, scarcely 10 per cent. in the earliest five rings, 40 to 50 per

cent. of the next one hundred rings, about 30 per cent. of the next fifty, and only 20 per cent. of the succeeding fifty rings.

When a pine log is sawn into planks, the sides of the middle plank may be taken as approximately radial sections, and on them the rings will appear as narrow parallel stripes alternately light and dark.

On the surfaces of other planks not passing through the centre—which are known as "bastard" planks—the rings appear as parallel but broader bands, with V-shaped lines towards the centre of each plank, while the bases of branches, or other projections, irregularities of growth, and the varying direction of the sawn surface with

Photo: H. Irving

Fig. 4.—The Douglas Fir

reference to the axis of growth, produce a charming variety of wavy and concentric bands of colouring. There is, for example, at Balmoral a room in which prayers are sometimes read which is panelled throughout with Scots Fir from the estate, which exhibits a wonderfully beautiful variety of figure.

Photo: H. Irving

Fig. 5.—Needles of (1) Cluster, (2) Austrian, (3) Scots, and (4) Weymouth Pines

Heartwood and Sapwood. — The developmental history of the various elements of the wood is fundamentally the same. They are all formed from the cells of the cambium, they increase in size, their walls become more or less thickened; but, as long as they retain protoplasmic contents, they behave as living cells. When they lose their protoplasm they cease to grow, though they may still act as conductive tissue, water and dissolved gases passing through them; they still serve the important purpose of mechanical support; nor is there any ordinary reason for their decay.

In the wood of Coniferæ, consisting as it does so largely of tracheids, it is these tracheids that convey water and air from the roots to the leaves, that store up starch in winter, and also support the weight of the tree. It is, however, only by the tracheids of the outer rings in a mature tree that all these functions are performed. This outer zone, generally from one to three inches across, and comprising some thirty to fifty annual rings, is known as the *sapwood*, or from its usually lighter colour, the *alburnum*, while the central mass is the *heartwood* or *duramen*. The deposition of tannin, gums, resins, etc., usually makes this heartwood darker in colour, especially in pines; but in spruces and silver firs there is but little difference in appearance between the two portions.

The heartwood is so far physiologically dead that it only performs the mechanical function of contributing to the support of the weight of the tree. The thickness of sapwood varies not only in different species, but also in different individuals, in different parts of the same tree, or even in different parts of the same growth-rings. It is narrower near the base and towards the top of a tree than in the main part of the stem; and it is wider in rapidly-growing trees, or in those grown in the open, as opposed to the crowded forest. In old trees the conversion of sapwood into heartwood proceeds more slowly. Thus, whilst in a pine a hundred years old only the outer thirty to sixty rings may be sapwood, in a tree of the same species 250 years old there may be seventy or eighty rings of sapwood.

Heartwood being heavier, and, on account of the smaller proportion of water that it contains, more durable, is generally the most valuable part of the tree, so that a high proportion of sapwood reduces the value of timber. Only for the manufacture of paper pulp is sapwood an advantage among coniferous woods. It is true, however, that sapwood can be more readily impregnated with chemical preservatives, and, when so impregnated, may equal

heartwood in durability and consequently in value.

Hard Woods.—It is the comparative simplicity of structure of coniferous woods, composed, as we have seen, almost entirely of tracheids in regular radial rows, which gives them a straight even grain, rendering them readily cleavable and easily worked with saw and plane; while their resinous character renders them durable. Growing rapidly, on poor soil, and with a large proportion of straight timber, they are applicable to a great variety of uses, and both the demand and supply of this class of wood is enormous. Directly we begin to examine the woods of broad-leaved trees—those technically known as *hard woods*—we find that, though pith, cambium, growth-rings, sapwood and heart, early and late wood, and rays are all present as in coniferous wood, so that the general plan is equally exogenous, the wood itself is more complex, being made up of a greater variety of elements, and these elements not being, as a rule, in the regular rows presented by the tracheids of conifers.

Pith.—The outline of the pith when seen in a sound cross-section of a hard wood is often characteristic. It may be nearly circular, with an even margin, as in elm, or with a wavy outline, as in horse-chestnut, hawthorn or laburnum; it may be oval, as in ash, maple, holly and plane; triangular, as in alder, beech, and birch; or five or six-sided, as in oak, poplar and willow.

Elements of the Wood.—It is, however, chiefly in the variety of the elements of which the wood is made up and in the varying proportions in which they are present that the hard woods differ from the soft woods. Instead of the functions of conducting water and affording mechanical strength being both performed by the same elements, as they are by the tracheids of the soft woods, these functions are separated in the hard woods. Vessels are always present to conduct liquid from roots to leaves, and mechanical strength is given mostly by wood-fibres. Some cellular tissue is generally also present, while tracheids may or may not occur.

Texture and Grain.—Two sets of characters of wood that are very often confused are texture and grain. Texture refers to the relative size of the elements of which the wood is made up; grain to their direction and the width of the growth-rings. In texture wood may be either coarse, fine, even, or uneven. Coarse-textured wood has many of its elements large, as, for instance, the wood of Spanish Chestnut. Fine-textured wood has its

Photo: H. Irving

Fig. 6.—Cones of Conifers showing attitude in growth: 1, Spruce; 2, Larch; 3, Weymouth Pine; 4, Douglas Fir; 5 and 6, Scots Pine, first year and full grown; 7, Cedar; 8 and 9, Austrian Pine, first year and full grown

elements mostly small, as in Willow or Poplar. Even-textured wood is that in which the elements are uniform in size, as in Box, Pencil Cedar, Horse-chestnut, etc.; uneven-textured, that in which they present marked contrasts in size, as when there is much difference between early and late wood, pitchpine and the ring-porous woods, oak, chestnut, elm, ash, etc., for example.

The various terms used by woodworkers in describing grain, such as coarse-grained, fine-grained, cross-grained, and spiral-grained, are not always employed in quite the same sense. *Fine-grained* should mean "with narrow growth-rings," that is slow-grown; and *coarse-grained*, with wide rings as the result of rapid growth; but in turnery and cabinetwork "fine-grained" is often applied to any wood susceptible of a high polish, that is practically to a hard or fine-textured wood; and "coarse-grained" conversely to wood that will not polish well, being soft, or of coarse texture. So, too, the term, *straight-grained* as applied to a tree or to unconverted timber should mean that the elements of the wood are parallel to the axis of growth; but when applied to a plank it means that its longer surfaces are parallel to the radius and the tangent of the stem, that is, that in cutting up the log the length of the plank has been kept parallel to the axis of growth. If this has not been done a "cross-grained" plank will have been cut from a straight-grained log.

As the strength of timber, especially in resisting a transverse or bending strain, diminishes in proportion as the plane of its elements deviates from parallelism with the longitudinal surface, this is most important in engineering or constructional work; and as, when split, wood cleaves in the direction of length of its elements, split wood is generally stronger—so far as such strains are concerned—than sawn stuff. Naturally cross-grained wood is produced when the elements are oblique and interlaced, not all lying in any one direction, so that, in working, the tool is sure to meet many of them at a wide angle with their longitudinal axis. This is notably the case with lignum-vitæ, which is employed accordingly for ships, pulleys, skittle-balls, mallets, etc. But whilst this cross-grained character need not interfere with the cleavability, or ease in splitting, of the wood, or diminish its strength when split, but may render it more tough, as the fibres will shrink in drying in the direction of their length, such wood will almost certainly twist or warp in seasoning. This is noticeably the case with the so-called "satin walnut," so that the cheap furniture made from it is unfit for employment in rooms in which fires are used, or other considerable changes of temperature are probable. Jarrah behaves in a similar manner when in thin planks.

It is not uncommon to find the elements arranged spirally round the axis of a tree, probably, in many cases at least, as the result of exposure to high winds.

Even-grain should apply to the regular circularity and uniform width of the growth-rings; but it has been described practically as one "that a sharp saw cuts directly through and leaves the surface compact and level"; while an "uneven" or "woolly" grain tears under the tool and leaves the surface rough with ragged ends of torn fibres. Perhaps the terms "smooth" and "rough" are preferable for these two conditions, "even" and "uneven" referring only to the regularity or irregularity of the growth-rings.

When the fibres undulate without crossing one another we get curly and wavy grain. When the folds or ridges are small and numerous we get the *curly* effect, frequent in maples; when the undulations are larger and less frequent we have the *wavy* structure. This is often found near the root or below the spring of large branches. The undulations of the elements are usually, but not always, in a plane tangential to the stem, so that the radial section is waved, but a tangential one smooth and exhibiting the ornamental grain. The exquisite grain of some sycamore and mahogany known as "fiddle-back" from its use in the case of the former, is of the nature of a wavy grain. Other variations of figure in mahogany are

known as "roe," "mottle," "cross-mottle," "dapple," "plum-pattern," and "curls." Two of the most beautiful pieces of wood known are a plank of Honduras mahogany, brought to England in 1816, now in Museum III at Kew, and one of satinwood from Ceylon, now at the Imperial Institute, London, to which the Grand Prix of the Paris Exhibition of 1900 was awarded.

The surface of the wood-cylinder, if the bark of a tree is removed, is seldom completely smooth, but is locally more or less pitted or channelled. These depressions on the surface can usually only be traced inwards through a very few annual rings. Such inequalities of growth in one year, that is to say, are generally made up in the next. In some woods, however, especially that of maples, these depressions are repeated year by year, although they are very slight in extent, generally less, in fact, than an $\frac{1}{8}$ in. in depth. In a tangential section they appear as rings or "eyes," in a cross-section as "pins." When numerous and small they produce the effect known as *bird's-eye* grain; and when wider, that known as *blister* or *landscape*. The latter name is appropriate, since the figure much resembles a contoured map.

Burrs.—On the stunted stems of shrubby plants, or the stumps of coppiced or pollard trees, or on the warty excrescences, known as *burrs*, produced on trees of various kinds by the attacks of mites or of fungi, numerous buds or rudimentary shoots appear, in no definite order. Each of these is a centre for the slow formation of growth-rings and the displacement of surrounding elements, so that—whether they grow out into the tangle of twigs known as a "witch's broom" or not—in the course of years a mass of wood several feet across may be formed, very dense, and with an irregular *gnarled* grain, somewhat resembling bird's-eye maple. Such burrs afford various very handsome kinds of veneer.

Knots.—A knot is the base of a branch, generally one the development of which has been arrested. Though a branch originates in a bud at the surface of the stem, it is not only added to year by year by newly formed wood so that it becomes a cone with its apex pointing towards the centre of the stem, but it also becomes embedded in the growth-rings of the stem

Photo: H. Irving

Spruce. Douglas Fir. Larch.
Scots Pine. Austrian Pine.

Fig. 7.—Shoots of Conifers

formed subsequently to its origin. The earlier the origin of the branch, the more deeply seated will be the knot.

The junction between the elements of the wood of the stem and those of the living branch differs on the lower and upper sides of the branch. Some elements from the stem bend outwards into the branch and are thus continuous with the elements of the branch; but the other elements of

the stem bend round the base of the branch and continue beyond it, so that there is no such continuity of tissue between the upper side of the branch and the stem above as there is between its lower side and the stem below. When young trees are at all crowded together most of their earlier branches are killed, and the subsequently formed growth-rings of the stem do not then as a rule unite their growth with the base of the dead branch, but merely surround and embed it. If the dead branch is quite small it will form what is known as a *pin knot*, and may be closely *encased* by the newer wood and be covered over or *occluded* by its growth, while quite *sound*, so that no visible sign of its presence may remain on the outside of the stem or log. If, on the other hand, the branchlet decays, it may give rise to a rotting or *druxy knot*, which, though a source of extending damage to the wood, may be similarly concealed.

A less healthy surrounding growth often leaves larger knots *loose*, and sometimes they may have split radially or have begun to decay before they are occluded. If sound, a knot is usually harder than the surrounding wood; and in coniferous trees they generally become extremely resinous. The resin will often preserve them when the rest of the wood decays, so that they may be collected from a forest of dead trees as valuable fuel. The same resinous character will make them refuse to take paint or varnish. Small knots may impart an ornamental figure to wood. Burrs, in fact, consist largely of a crowded mass of such knots, presenting a series of small growth-rings, each with a central dark speck marking the pith.

As we have already seen, the outward and lateral bending of the elements below a large branch also produces handsome grain; but, in general, knots are defects, making the wood less easy to work or split and less able to withstand bending or pulling strains. For the structural reason just explained, it is found in splitting the wood of a stem that the knot splits with it if the split is started from below, but not if it be started from above.

Common defects found in converted timber will be dealt with in detail in a later chapter concerned with the conversion of tree trunks into commercial timber.

PROPERTIES OF WOODS

Though it is probably not altogether logical or scientific, it is convenient to group the characters of woods as structural, physical and mechanical.

Unquestionably the two most prominent characteristics that make up the appearance of wood are its grain and its colour. We propose, therefore, to begin the examination of the physical properties of woods by dealing with those properties that are most obvious to our unassisted senses, colour, lustre, odour, taste, resonance, and other forms of conductivity.

Colour.—When first formed, wood is nearly, if not entirely, colourless. The sapwood may become yellowish after a few years, but does not produce the varied tints of heartwoods. In not a few woods, such as silver firs, spruces, birches and horse-chestnut, there is little or no difference in colour between sapwood and heartwood; whilst in others there is a marked contrast. The deeper colour of the heartwood is due to the infiltration of resinous, gummy, tannin-like and other pigments into the walls and cavities of its elements; and, as these substances add to the durability of the wood, the depth of the colour is generally taken as a criterion of durability. There are many cases, however, where such infiltrating substances are not deeply coloured and where the heartwood may be durable without much deepening of colour.

Exposure to air and light darkens the colour of all wood, probably by the oxidation of the colouring-matters. This is strikingly seen in our common alder, the wood of which is white when growing, turns a deep pink on being felled, and finally becomes a light brown. Prolonged immersion in water produces various colour-changes in woods. They often turn grey, as in the spa wood or silverwood used for bric-à-brac. Yew, buried in peat, becomes a dark brown; whilst the tannin

Photo: G. Clarke Nuttall

Fig. 8.—The Ash in Summer

whether such insect-eating birds would ever attack a previously sound tree. Such patches of discoloration are specially to be looked for at the butt ends of logs. If fungoid, these usually begin white, becoming later reddish-brown, or *foxy*.

The decay often begins at the pith, and may result in the destruction of all the heartwood, making the tree hollow, although the active growth of the cambium may continue. Decay may, however, originate in a broken branch, or some local injury from the outside, or by the accumulation of water and dead leaves. English oak, with such foxiness or incipient decay when first so affected, is in special demand as "Brown Oak" for ornamental use, in purposes in which the loss of strength is not of consequence.

in oak combines with iron-salts in peat-water and dyes the wood jet black with a natural ink.

For some purposes wood is required to be free from colour. Perfectly white sycamore wood—known as Plane in the trade at Glasgow—is in demand for bread-platters, butter-moulds, and the rollers of mangles; and light-coloured woods are also preferred for spokes and tool-handles, under the mistaken generalisation that dark-coloured heartwoods, though heavy and hard, are brittle rather than tough.

Coloured woods, on the other hand, are specially valued for panelling, cabinet-making, furniture and inlaying—such as the black ebonies, rosewoods, mahoganies, walnuts, etc.

Scattered patches or streaks of discoloration, that is of colour unlike that of the rest of the wood, are usually symptomatic of disease. Dark stains may be partial decay, which may originate in the holes made by woodpeckers, followed by rain and fungoid growth, although it is doubtful

Lustre or Gloss.—Wood being naturally translucent, its fibres, seen through its translucent surface, reflect a varying amount of light and so produce the lustre or gloss of the wood. A small degree of lustre is exhibited by most sound wood; but when wood is attacked by fungi it becomes

Photo: G. Clarke Nuttall

Fig. 9.—The Ash in Winter

more opaque and dull, or, as it is technically termed, "dead," instead of "live."

The natural lustres of sound woods differ much in degree, and true lustre must be distinguished from such merely superficial reflection of light as is obtained from any polished or varnished surface. Beech, plane, or American walnut, for instance, have so little natural lustre that they may be termed *dull* ; spruce has a *pearly* lustre ; lignum-vitæ, one that may be described as *greasy* ; while the lustre that gives its name to the silver-grain of the "mirrors" of the pith-rays is very similar to that called "pearly" on the ordinary tangential section of spruce. Finally, the parallel and often curled fibres, visible through the light-coloured surface, give the beautifully *silky* effect that gives its name to satinwood.

Odour.—The production of an odour by wood implies the giving-off of some volatile substance. In many cases the smell is so slight or so evanescent as to escape notice ; and it is generally more pronounced in moist green wood than in dry or seasoned material, and in heartwood rather than in sapwood. Prolonged exposure to air or submersion in water will usually deprive at least the exposed surface of the wood of its odour ; but in other cases the scent will be again emitted for an almost indefinite time on the exposure of a fresh surface.

The turpentines of pines, larches, spruces and silver firs are volatile oils with resins dissolved in them, and their smell is known either as *resinous* or *turpentinous*. Cedar-wood oil, used for perfuming fine soaps, is obtained from the wood of the pencil cedar. Cedar is valued for cabinets, wardrobes, chests of drawers, etc., though the perfume soon leaves the exposed surface.

The cedar-wood of the English timber-trade is not coniferous ; it is an ally of the mahogany, often known from its chief use as "cigar-box cedar." The wood is imported from Havana, Jamaica, and Honduras. It has a somewhat more peppery smell than that of pencil cedar.

Resonance.—It is mainly owing to its elasticity that wood can either receive from, or communicate to, the surrounding air the vibrations of which we are conscious as sound. The vibrations of the air, caused, for example, by the motion of the strings of a piano, can communicate themselves to a thin board, causing it to vibrate with the same intervals as the string and thus to transmit and reinforce the note. Any piece of wood struck by a hammer will give out a sound which will vary in pitch and in intensity according to the shape, size, kind, and condition of the wood. As musical sounds differ from mere noises essentially in being made up of regular periodic vibrations, it is obviously essential that the wood used in the construction of musical instruments should be, and should remain, as uniform in texture as possible.

Knots, resinous patches, sharply contrasted early and late wood in the growth-rings, as in our ring-porous hard woods, or alternating wide and narrow growth-rings, are, therefore, defects and would cause woods to be rejected for this purpose. That it may retain its form without twisting it is essential that the wood should be thoroughly seasoned ; but the mistake has been made by some modern French makers of violins of using old and dry woods. Wood has its maximum elasticity, combined with stability, when just seasoned ; and it was at this stage that the great Italian makers shaped their wood and protected it with their incomparable varnish. In order that each fibre of the wood may vibrate freely it is desirable that the wood should not be bent into shape or put in any condition of extreme or deforming strain. The belly of a violin is, therefore, cut from a thick piece of wood, and is not bent into shape.

Although any well-seasoned ornamental wood, such as rosewood, mahogany, walnut, or veneered material, may be used for the cases of pianofortes, it is most desirable that even in this part of the instrument there should be an absence of knots, contrasts of grain, joints, especially open ones, or other possible interferences with the regular transmission of the sound.

Conductivity.—The variation in the action of wood as a conductor of heat or

electricity depends mainly upon the density and moisture of the wood, rather than upon any specific characters. Dry wood is a poor conductor either of heat or electricity. The wooden handles of metal tea-pots and of soldering-irons illustrate the former fact. As increased density increases the conductivity, the late wood is a better conductor than the early, and a section with the grain, affording continuous bands of late wood, will be a better conductor than one cut across the grain so that the bands of early and late wood alternate. It may, therefore, be worth while in the case of such handles as those just mentioned to see that the grain of the wood runs across the handle. Increase of moisture increases the conductivity both for heat and electricity. This is a matter of some practical importance. It has been found, for instance, that electric wires cased in wooden boxes may cease to be insulated if the boxes can become saturated. Such wood ought therefore to be filled with some preservative of a non-conducting character. Resins and oils being bad electrical conductors, porous and resinous woods are adapted for such purposes, which are being better met by other means.

WEIGHT, DENSITY AND SPECIFIC GRAVITY

Woods weighed in the mass vary immensely in their apparent weight, more especially with reference to the amount of water and air they contain but also with regard to their compactness, that is, the amount of woody or other solid matter in a given bulk. To speak more precisely, the weight of wood depends upon the closeness with which the wood-elements are crowded together, the density of the walls of the elements, and the nature of their contents. Most woods, with the exception of a few tropical species, float in water, and this is a matter of the greatest consequence with regard to the transport

Fig. 10.—Various Leaves: 1, Beech—oval, edge wavy; 2, Oak—oblong, deeply wavy; 3, Sweet Chestnut—narrow, broadly sawed; 4, Birch—doubly sawed; 5, Lime—heart-shaped and oblique; 6, Sycamore—heart-shaped, five-lobed; 7, Maple—kidney-shaped, five-lobed

of newly felled trees from the forest to the port, and of much converted timber which is floated in rafts down the great waterways of the world. This floating is, however, due to the air imprisoned in the wood. A single wood-fibre dried and thrown into water will float, as will an empty bottle with a cork in it; but after a time it will become waterlogged and sink.

Undried sapwood will sink sooner than dried wood, because its elements are already more or less filled with water; and the more compact, slower-grown hard woods, especially those tropical species to which allusion has just been made—which have more crowded and thicker-walled element—will become waterlogged sooner than pinewood. The amount of water in woods varies not only in the species, but in the individual, in different parts of the same tree, and according to the extent to which it has been seasoned. No comparison of the weights of different woods can, therefore, be of any value unless this misleading factor, the moisture-content, has been as far as possible eliminated by kiln-drying. Many published weights of wood are rendered entirely valueless by the absence of any precise indication as to the amount of moisture present, such vague terms as "air-dried" being used, or even the distinction between sapwood and heartwood being ignored.

The substance of the wood, on the other hand, is, bulk for bulk, of very much the same weight in different trees, varying little below 1·5 or above 1·6 times the weight of water. A good-sized log of pinewood may float for months before the water will have filled most of the closed thick-walled elements of the heartwood; but a small fragment of wood cut across the grain, so that the elements are open to the access of water, will sink almost immediately. It is possible with such a fragment to determine the weight of the wood-substance with tolerable precision by immersing it in a series of liquids of varying specific gravity until we find one in which it neither sinks nor rises if immersed. To do this accurately, however, the wood should be boiled for some hours in calcium-nitrate or some zinc salt to replace all the water and air in its cavities. Another method has been adopted in which the wood is rasped to a fine powder, dried at boiling point, weighed and then put into a weighed bottle of water from which the air is exhausted and left for six days and then weighed.

If then we eliminate the moisture factor at least to a uniform degree by kiln-drying all samples, and take the actual density of the wood-substance to be the same in different woods, then differences in measured weight will depend mainly upon the amount of this wood-substance that may be packed into the unit of volume taken.

In practice the weight of wood is calculated from small sound specimens of heartwood (unless otherwise specified) oven-dried at the boiling-point of water until their weight becomes constant. Various causes, however, such as rate of growth, may cause such wide variations that any single weight stated should be the average of many determinations; or if the extreme results are given they will commonly be found to be very far apart.

Density being thus the weight of a unit of volume, it is stated in grams per cubic centimetre, in kilograms per cubic metre or stère, or in pounds to the cubic foot. For commercial purposes the density of "air-dry" or "shipping-dry" wood is usually stated in pounds per thousand board-feet, a board-foot being one-twelfth of a cubic foot. If a wood weighs less than 24 lb. to the cubic foot it may be termed *very light;* if between 24 lb. and 30 lb., *light;* if between 30 lb. and 36 lb., *medium;* if between 36 lb. and 42 lb., *heavy;* if between 42 lb. and 48 lb., *very heavy;* and if above 48 lb. to the cubic foot, one of the *heaviest*.

We are inclined to think that the weight of a cubic foot, which is often represented as the value of W, is the most practically useful method of testing the density of woods; but it is very often given in the form of specific gravity. Specific gravity is the ratio of the weight of a substance to the weight of an equal volume of some substance taken as a standard. The standard we use for solids is distilled water

at the temperature at which it is at its maximum density, namely 4° centigrade (39·2° F.). At that temperature a cubic foot of water weighs 62·43 lb., so that if S.G. be used to symbolise specific gravity:

$$\frac{W}{62{\cdot}43} = \text{S.G. or S.G.} \times 62{\cdot}43 = \text{W.}$$

If we add to the scale of weights we have just given the corresponding specific gravities, and some examples, we get the following table :—

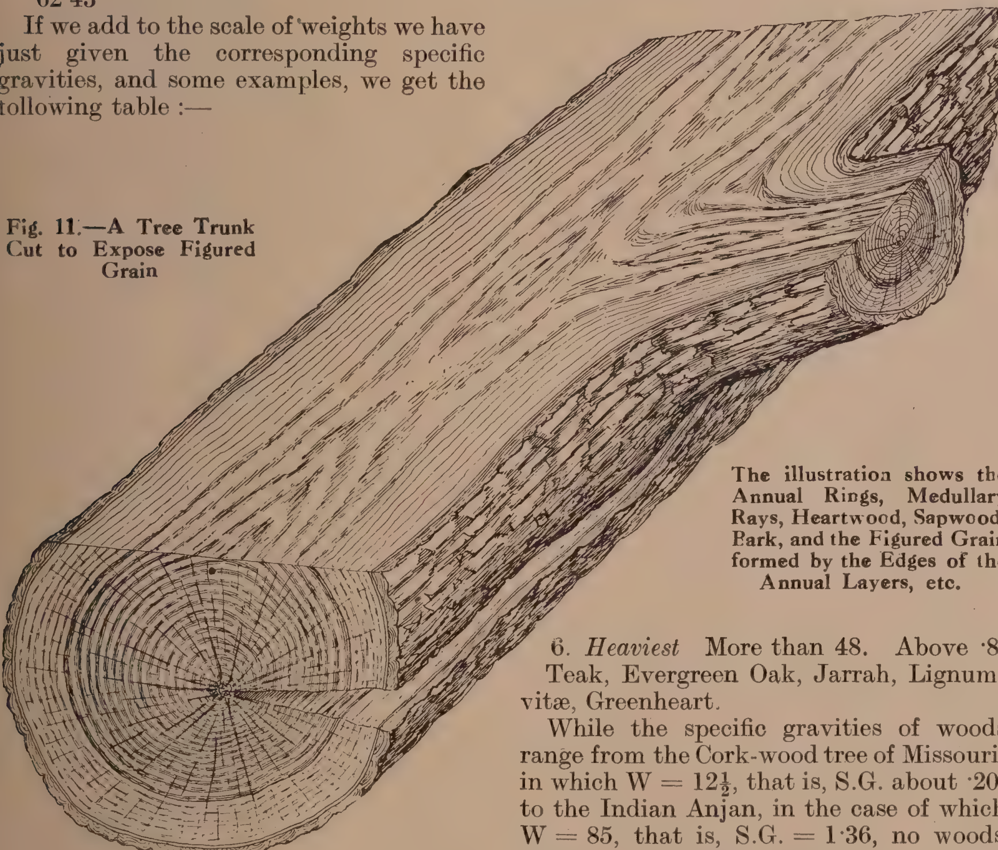


Fig. 11.—A Tree Trunk Cut to Expose Figured Grain

The illustration shows the Annual Rings, Medullary Rays, Heartwood, Sapwood, Bark, and the Figured Grain formed by the Edges of the Annual Layers, etc.

	W.	S.G.
1. *Very Light*	Not more than 24.	Not more than ·4.

Most Spruce, Willow, Poplar, Yellow Pine.

2. *Light*	24 — 30	·4 — ·5

Linden, Chestnut, Canary Whitewood, Scots Fir, Pencil Cedar, Californian Redwood, Hemlock Spruce.

3. *Medium*	30 — 36	·5 — ·6

Douglas Spruce, Sycamore. Satin Walnut.

4. *Heavy*	36 — 42	·6 — ·7

Most Birch, Beech, Walnut, Elm and Ash.

5. *Very Heavy*	42 — 48	·7 — ·8

Hornbeam, Hickory, Mahogany, Locust, White Oak, good Ash and Elm, Persimmon.

6. *Heaviest*	More than 48.	Above ·8.

Teak, Evergreen Oak, Jarrah, Lignum-vitæ, Greenheart.

While the specific gravities of woods range from the Cork-wood tree of Missouri, in which W = $12\frac{1}{2}$, that is, S.G. about ·20, to the Indian Anjan, in the case of which W = 85, that is, S.G. = 1·36, no woods native to temperate latitudes are, when dry, as heavy as water. Nearly all the woods in the sixth of the grades given above are, in fact, tropical.

Moisture-content.—We have already had occasion to refer to the constant presence of more or less water in wood as affecting its conductivity. It is still more important in its influence upon hardness, strength, and durability.

Water occurs in the sapwood of a living tree under three conditions. It forms more than 90 per cent. of the protoplasmic contents of the living cells ; it saturates

the walls of all the elements of the wood; and it occurs free wholly or partially filling the cavities of the cells, fibres, tracheids and vessels that have lost their protoplasmic contents. In heartwood it will only occur under the two last-mentioned conditions. In the freshly-felled wood of the tree which is known in the United States as white pine, to the Liverpool timber trade as yellow pine, and in our plantations as Weymouth pine, for example, water forms about half of the total weight of the wood; and it is estimated that of this amount less than 5 per cent. will be in the protoplasm of living tissue, 35 per cent. will be in the cell-walls, and 60 per cent., the free water or sap as it is commonly called, in the cavities of the elements that have lost their protoplasm. The amount will, however, vary greatly according to the species, the season of the year, and the part of the tree from which wood may be obtained.

While freshly-cut poplar has been stated to contain 44 to 52 per cent. of water, and oak, beech, elm and linden from 34 to 47 per cent., birch has been described with 30, ash and maple with 28 and 27 respectively, and hornbeam with only 18·6 per cent., though it may be doubted whether these figures have a general application. Water is probably at its maximum in the living tree when the roots are most active and the sap is rising. Thus, silver fir was found to contain 53 per cent. in January and 61 per cent. in April; Ash, 29 per cent. in January and 39 per cent. in April. As the proportion of water present diminishes gradually from the bark to the pith if there is no heartwood, or with a sudden reduction at the junction of heartwood with sapwood if heartwood is present, more water will be found, in proportion, in the younger shoots, twigs and branches than in the main stem, more in the upper part of the stem than in the lower, more in a young tree than in an old one.

The percentage of moisture present can be readily ascertained, but will appear at very different figures according to whether it is computed by comparison with the original or fresh weight of the wood or with reference to its weight when dried. A thin section of wood is sawn off, weighed carefully on a delicate balance, dried in an oven at the temperature of boiling water until its weight is found to be stationary, and re-weighed. The difference between the first or fresh weight and the final or dry weight is, of course, the amount of water given off. The percentage of moisture present with reference to the fresh weight will $= \dfrac{\text{Fresh weight—dry weight}}{\text{Fresh weight}} \times 100.$

Thus, if the dry weight is only half the fresh weight, 50 per cent. of that original weight was water. If, however, we refer the percentage of moisture to the dry weight, percentage of moisture $= \dfrac{\text{Fresh weight—dry weight}}{\text{Dry weight}}$ $\times$ 100, the moisture given off will be seen to be 100 per cent.

Winter-felled wood in Europe retains more than 40 per cent. of moisture until the end of the following summer, and even after being kept for several years in a dry place, as in what is known as "natural seasoning," from 15 to 20 per cent. may remain.

Except when there are extensive cracks or "shakes" in the wood, or when the wood is exceptionally sappy and the weather is warm, water does not escape from timber in a liquid form, but must be removed by evaporation. The rate at which this takes place under natural conditions depends upon the kind of wood, upon its structure, upon the size and shape of the piece, upon the area of the exposed surfaces, and whether they are radial, tangential or transverse, and upon the condition of the surrounding air as regards temperature, moisture, and movement.

Difference in the thickness of the walls of the elements is, for instance, apparently a reason why pine should dry faster than oak. Its greater relative surface causes an inch plank to dry more than four times as fast as one 4 in. thick, and more than twenty times as fast as wood 10 in. thick.

A cross-section may in an hour—from the open ends, that is, of the elements—give off four times as much water-vapour per square inch as a radial section will do. A high temperature will cause more rapid evaporation, even if the surrounding air is very moist.

Drying can take place to a considerable extent in hot steam and to some extent even in boiling water. Wind, however, by removing successive bodies of air laden with the moisture resulting from evaporation, will hasten the drying of timber.

If the air is artificially dried by the use of such chemicals as caustic lime, the wood, though parting with some moisture, will yet retain some; and even if oven-dried at 120° F. will still lose more water at 200° F. It is impossible to remove all the water from the wood without destroying it; so that, for practical purposes, wood is considered to be thoroughly dried when its weight remains unreduced at a sustained temperature of 212° F. (the boiling-point of water), although 2 or 3 per cent. of moisture will then remain in it.

The presence or absence of the free water in the cavities of the wood-elements does not apparently lessen or increase the strength of the wood, such effects being entirely due to the water with which the cell-walls may be saturated. The presence of this water renders these walls soft, pliable and weak; its removal will increase the hardness, resilience, and strength of wood. Thus a small block of green spruce will, when dried, support a load four times as great as it would when wet. In large timbers, however, the resultant splitting or "checking," as it is termed, may entirely counterbalance any increase of strength due to drying. It is consequently unsafe, in calculating the strength of large timbers, to assume that they will be any stronger dried than when green. As examples of the gain in strength produced by drying, we may specially cite the soft-wood cross-arms for telegraph-poles, and the hard-wood spokes and handles in wheelwrights' and implement-makers' work.

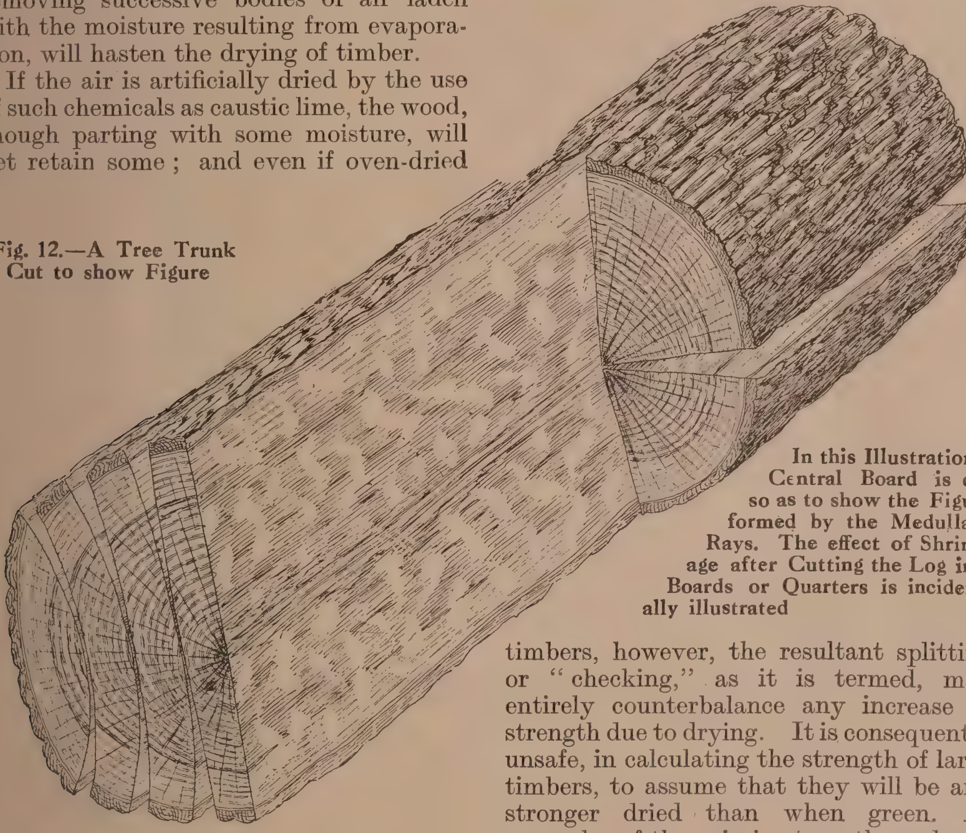


Fig. 12.—A Tree Trunk Cut to show Figure

In this Illustration a Central Board is cut so as to show the Figure formed by the Medullary Rays. The effect of Shrinkage after Cutting the Log into Boards or Quarters is incidentally illustrated

Shrinkage.—Water forming so considerable a proportion of the substance of living wood, it might be expected that a loss of water would bring about shrinkage. This is, however, not the result of the loss of the free water in the cavities of the

wood-elements, but of that which saturates the cell-walls. The shrinkage mainly affects the width of the wood-elements, not their length; but, as the elements of the pith-rays extend radially, in shrinking they contract in the directions of the height and width of the ray, thus producing some longitudinal shrinkage of the wood as a whole. In any case longitudinal shrinkage is small in its total amount, being greatest in woods with curly grain

Photo: H. Irving

Fig. 13.—Trunk and Bark of Oak

or broad rays, but not exceeding ·1 to ·3 per cent. of the total length.

Warping.—Even in the case of wood of uniform texture and straight grain, in which as a rule the distortion or *warping* due to unequal shrinkage will be reduced to a minimum, considerable shrinkage of this character may be produced by rapid unequal drying. Thus a plank of green wood exposed to the heat of the sun, or of a fire, will dry and shrink much more rapidly on the side exposed to the heat and curl up accordingly. Such warping, however, due as it is to a merely temporary inequality in the distribution of water in the plank, can generally be corrected by completing the drying process for the whole. On the other hand, warping due to such irregularities of structure as cross grain or spiral grain cannot as a rule be corrected. The so-called satin walnut or red gum jarrah, especially when in small pieces, and to some extent elm and beech, are liable, from the complex internal strains set up by their structure, to warp in various directions so that they become twisted.

We have already stated that shrinkage in length, that is with the grain, is far less than that which takes place radially. There is, however, another inequality in shrinkage of almost equal importance, that namely between the radial and the tangential direction. In the radial direction there is very slight shrinkage of the pith-rays, because that is their longitudinal extension; but there is the lateral shrinkage of the tracheids or fibres of the wood itself. This latter, however, is made up of the shrinkage of longitudinal bands of late wood separated by bands of early wood that shrink less. On the other hand, in the tangential direction, that is, practically along the growth-rings, the greatly-shrinking late wood is continuous; and consequently, as the late wood also represents as a rule the greater part of the wood-substance, the shrinkage in this direction is greater than that produced radially. The difference between radial and tangential shrinkage is generally in a ratio of about 2 to 3.

Splitting or Checking.—The more rapidly wood is dried, the greater is its tendency to split. When in the round, wood splits mostly in the direction of the pith-rays, that is, where the unequally-shrinking rays and wood are in contact. If a log is sawn in half longitudinally through its centre, the flat surface will, for the causes just explained, become convex. If a plank is cut from the middle of a log, that is, so as to include the centre growth-rings in its end section, when it is known as "box-hearted," both surfaces will be drawn into a convex curve and

some of the radial checks may open lengthways. If the half log just described be sawn into planks parallel to its flat surface, each of them will so shrink that the side nearer to the centre of growth will be convex, that nearer the outside, concave.

Cracks from the ends of converted timber may be prevented by stopping the drying at the ends with a coat of paint, by dipping the ends in melted paraffin, or gluing paper over them. Other substances, such as tar, linseed oil, or clay, are sometimes used for this sealing of the cut ends of the wood-elements, more especially in the case of valuable woods. Driving S-irons, or preferably thin steel clamps, into the ends of logs when the checks first appear is another method of preventing logs from splitting up. The most approved modern form of these irons is made by running a thin strap of iron with one tapered edge between cogs so as to crimp it into S-curves, which can then be cut to any desired length, the taper edge being readily driven into the wood.

Split wood is straighter in grain, and therefore more easily seasoned, without checking, than sawn timber. When it is to be sawn, timber will warp and check less if sawn as nearly as possible along the radii of the growth-rings, that is, "quartered," "rift-sawn," or "wainscot." On the Continent, it is usual in converting oak timber to take off two lateral "checks" from the log and a central plank with the usual "star-shake"—or radiating centre splits produced during growth—in it, these being considered as waste. The remainder is then sawn into planks parallel to the checks. The English method of quartering large logs is merely to saw the log longitudinally through the growth-centre in two directions at right angles to one another, the quarters being then sawn into planks parallel to either longitudinal section.

MECHANICAL PROPERTIES OF WOODS

The fitness of a wood for any particular purpose is never determined by one character alone, but invariably by its possession of two or more qualities together. Thus the spoke of a wheel must not only be "strong"—a somewhat vague quality—but must definitely be stiff to retain its shape under strain, hard, so that the tenons will not become loose in their mortices, and "tough" to resist shocks and twisting strains.

The mechanical properties of woods are, it has been well said, being continually put to the practical tests of everyday life. The stiffness, hardness and toughness of

Photo: H. Irving

Fig. 14.—Trunk and Bark of Scots Pine

every joist, rafter, window-sash, door-frame or flooring plank in our dwellings, of the chair we sit on, and of the boat or carriage in which we travel, are being tested by use as to the loads they can carry, or the other stresses they can withstand. So, too, every step we take in woodworking, from the splitting of fire-wood or of laths for thatching, or the "rending" of oak fencing, to the construction of the most delicate and elaborate piece of bric-à-brac, involves the practical,

if unconscious, recognition of some of the mechanical properties of the woods we employ. At the same time mo t of these mechanical properties can be included under the general term "strength," and their detailed analysis and precise measurement chiefly concern the engineer and the builder of boats or of houses who deal with constructional timber, rather than the small woodworker.

Strength.—All measurements of the strength of timbers are determinations of their powers of resisting certain stresses, or forces tending to produce strains or changes of shape. There are, however, in these problems two complex sets of factors to be analysed, namely, the structure of the wood and the nature of the stress.

Stress, or distributed force, may be considered either extremely as the action of one body on another, or internally, according to the tendency of one part of the body acted upon to move with reference to another part. The intensity of stress is expressed in weights (pounds, tons), per unit of area (square inch).

Normal stresses which are considered as being exerted at right angles to an imaginary cross-section will be either *tensile*, or of the nature of a *pull*, or *compressive*, that is of the nature of a *push*. Such simple longitudinal stresses may be illustrated by a rod or rope stretched by force at each end, or by a block or short pillar compressed by opposite forces acting at its ends.

Strain is the change of shape produced by stress. In a simple longitudinal pull or tensile stress the deformation will consist of a lengthening in the direction of the pull, accompanied by compensating contraction in both directions at right angles to the pull. If the stress be compressive, the strain will similarly be a shortening in the direction of the push.

Any stress that tends to cause part of a piece of wood to slide upon an adjacent part will be a shearing stress or *shear*.

Transverse, Bending or Cross-breaking Strength.—The term "strength," when used without qualification, generally means the breaking weight under a bending test. The stress is in reality a complex one, involving compression on the upper or concave surface, tension on the lower or convex surface, and some longitudinal shear; but it is one which can be applied and measured with very simple machinery and with accurate results. Beams are subjected to transverse stress. The load that any beam will safely carry can be easily calculated, usually by means of a simple mathematical formula.

Flexibility.—It is a further instance of the complex structure of wood that we cannot simply define its property of flexibility. It is to some extent the negation of stiffness. Thus moisture softening wood renders it less stiff and more flexible, so that green woods are more flexible than dry. The interlacing of the elements in some woods, such as elm and ash, due to the independent elongation of each element, enables them to bend to a great extent without fracture, and thus, though stiff, they rank as flexible Hickory and ash are among the most flexible of woods, and, speaking generally, hard woods are more flexible than the stiffer conifers; but some of the characters of woods that are spoken of as flexible may, perhaps better be treated under the admittedly more complex character of toughness. As opposed to elasticity and to toughness, flexibility should mean merely the readiness with which wood can be bent (*pliability*) without rupture.

Toughness.—Though it is a term commonly used by woodworkers, toughness is not often defined, nor is it easy to define, being unquestionably used somewhat ambiguously. It is sometimes applied to a wood merely because it is difficult to split, which will often only mean that the fibres are interlocked, that is, that the wood is cross-grained. If a wood can be bent considerably in one direction without rupture, it ought, perhaps, only to be called flexible, but is often styled tough. Green willow shares such flexibility with ash, hickory and yew; but is not tough as they are.

Conversion, varieties, etc., of timber are dealt with in later chapters.

Glue and Gluing

To woodworkers in general a good understanding of glue and the best methods of using it is essential for the production of reliable work. Glue is made by boiling the skins, hoofs, and bones of animals and straining the product into coolers where it stiffens into a jelly. This is cut into thin sheets and dried on frames of wire netting. The marks of the netting can often be seen on the cakes of glue as bought.

The importance of gluing in woodworking, particularly furniture making, is underestimated. Good glued work with seasoned wood will last a hundred years or more, and a glued joint well made is as strong as the solid wood, to prove which statement it is only necessary to glue together two pieces of thin stuff (say ½-in. boards), when it will usually be found that on trying to break the joint the boards will break elsewhere.

In many cases, however, the joints do not stand good, due to the wood being insufficiently seasoned, indifferent workmanship, careless gluing, or poor quality of glue. Either one or more of these causes are usually responsible for much rickety furniture, often when it has only been in use for a few years.

Varieties and Qualities of Glue.—Glue is manufactured in cakes of about 6 in. or 7 in. square, by ¼ in. thick, and sometimes oblong half that size. The varieties generally used are Scotch, English, and French; and although, as a rule, they are all good, the Scotch is acknowledged to be the best; that is, the strongest adhesive.

The cakes are often stamped with a name or brand by which they may be recognised as of reliable quality, and "Extra" means extra strength. It seems that the half cakes, unstamped, are not quite up to the standard, though they are often strongly adhesive and make an excellent glue. But it is only reasonable to expect that makers of a good glue will stamp their product.

In appearance glue should be of a clear amber colour when held up to the light; when cloudy it is usually inferior. In the cake form it is somewhat susceptible to changes of atmosphere. In a dry atmosphere it will be hard and brittle, and in dampness it will become pliable according to the degree of dampness. The least susceptible it is the better. A good cake of glue should never be extremely brittle; it should have some degree of toughness which can be tested by breaking it up. It has to be broken up in small pieces to "make off," which is done by wrapping in a piece of tough paper and smashing up with the hammer. This wrapping up is to prevent the pieces flying about as the glue is broken. The best glue is not so easily broken up small because of its toughness, even when it is quite dry. Glue that is very dark in colour or mouldy, or has an obnoxious odour should be avoided. The latter is glue gone bad, or the materials from which it was made had gone bad. It can be

used very thin as size or for making size-colour (so often required in furniture work) if not too bad; but sometimes the objectionable smell remains for a long time.

On the whole it is best to use glue sufficiently fresh for sizing even though

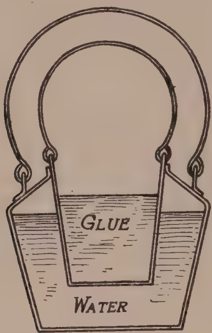


Fig. 1.—Section through Glue-pot

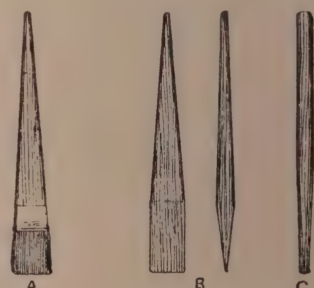
not up to the standard as regards adhesive properties. The standard quality will do for general woodwork and the extra strength when the occasion requires.

For some work the clearest possible glue should be obtained (the thin French glue, quite clear), notably in repairing veneered work in satinwood, bird's-eye maple, or other light woods; otherwise the joint is apt to show conspicuously.

Glue appears to be the same kind of substance now as that used on woodwork centuries old. It has served its purpose well, according to the skill of the workman in adapting it, and little thought seems to have been devoted to its improvement except in the last two or three years, during which "Croid" glue has become popular; this glue is not made of the traditional materials.

The ordinary glue has been taken for granted, and a considerable part of a woodworker's skill consists in his ability in using it. To do perfect work he must be able to judge its consistency, its temperature, etc., for each particular purpose. The atmosphere he is working in must be right, and he must know what to do should it be against him. For instance, in some pieces of woodwork many joints have to be managed at one gluing, and the worker cannot move too quickly to prevent the glue from chilling before all are safely cramped up. Although glue must be used amply, the least possible should be left between the united surfaces, because being susceptible to climatic influences, there should be nothing there to be affected, so long as the wood fibres are united. "Croid" is a liquid glue that "does not chill," being "used cold"; it thus gives much greater freedom in applying, and saves the trouble of heating the work, etc. Such a glue is extremely useful to have handy for emergencies, which are always happening; both for workshop and home use it can be handled with a much better chance of success by the average worker and the beginner. It saves heating up the glue-pot, or keeping it always ready on the stove. "Croid" glue is also claimed to "resist damp and heat," and to be the "strongest glue known." It has been used extensively in aircraft construction. "Croid" is used direct out of the tin, no glue-pot being used, which is very convenient.

However, the old glue-pot system has served well so long that it will not easily be superseded. The fact remains that at present there must be millions in use.



Figs. 2 and 3.—Glue Brushes and Sticks

It is a good plan to have a small-size glue-pot for general use, as it is handy for lifting about, is quickly heated up, and can be frequently changed; a large-size glue-pot is best for extensive work, veneering, etc.

In the cabinet-making factories the

system is to keep a convenient number of glue-pots always ready on the stove, to be taken as needed ; but for some classes of work, such as bamboo furniture making, the glue is so continually in use that each

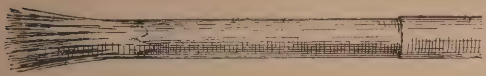


Fig. 3A.—Glue Brush made by Hammering Piece of Cane

workman has a gas-ring and tube, with glue-pot, by his bench.

Heating the Glue.—The glue-pot (Fig. 1) is, as a rule, still the same simple appliance that has been used by generations of craftsmen. The receptacle for glue is suspended inside the outer vessel or water container (Fig. 1). Both inner and outer vessels are of cast iron, and will last for generations providing they are never burnt dry or get cracked. Indeed, it is surprising how many times they do burn dry without cracking. When that happens they should be allowed to cool gradually before putting water in.

There are two shapes as regards the glue-pan, the flat bottom and the cauldron, which has a round bottom and three stumps to stand on when lifted out of the water-container. It is frequently necessary to lift the glue out, and when put down anywhere the flat bottom makes a nasty wet mark ; with the round bottom the wet dries off. This is an improvement in the hands of a careful workman, but the glue is more easily upset than in the flat-bottom pan.

A slight inconvenience occurs when the water boils over, making a splutter and a mess ; but that is due to too much water or too much heat. When this happens the glue-pan is lifted up and a nail may be put under the flange rim to allow the steam to escape. In view of this some glue-pots are made having three small lugs under the flange which fit into corresponding recesses in the rim of the water vessel. When the glue-pan is turned with the lugs out of place the steam escapes and the water will not boil over.

There are special heaters for the glue-pots, consisting of an iron casing over the Bunsen gas-burner, for safety and to economise the heat. They are made to take a single glue-pot or double or treble.

Glue Sticks and Brushes.—For stirring the glue and applying it, glue-sticks are used, the most convenient shape being one made from a bit of $\frac{3}{8}$-in. wood dowel, thinned down to about $\frac{1}{4}$ in. at the wet end. This is used for gluing dowel-holes when jointing, and is always kept in the glue and used as a stirring stick. A flat stick is also useful, shaped similar to the blade of a putty-knife, for use in mortise holes and on tenons, etc. When the glue is "made off"—that is, in liquid—the glue brush is put in, being necessary for many purposes when the sticks are not suitable, such as applying glue quickly to "rubbed" joints, surface work, etc.

In many cabinet-making and furniture-repairing shops, a stick and brush are kept continually in the glue for applying

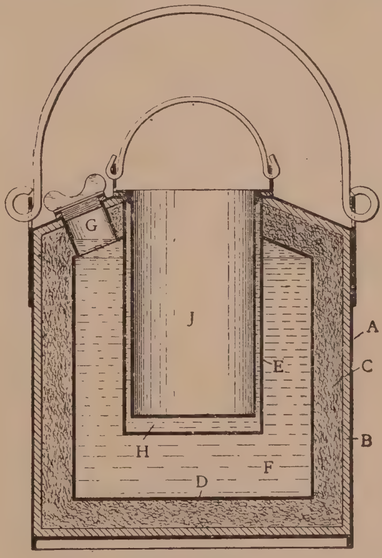


Fig. 4.—Three-vessel Glue-pot

it ; these should be of a convenient shape and size. Figs. 2 and 3 show glue brush, etc. ; A is a flat brush, 1 in. wide, which is very suitable. A handy shape for a glue-stick for gluing mortise holes, loose joints, etc., is shown at B, whilst C shows a round

stick, which is simply a piece of dowel made thinner at one end; it is useful for putting glue in dowel-holes, holes for spindles, etc.

Special glue brushes are obtainable from tool merchants. They are cheaper than paint brushes and, being iron bound, are more suitable. String-bound paste

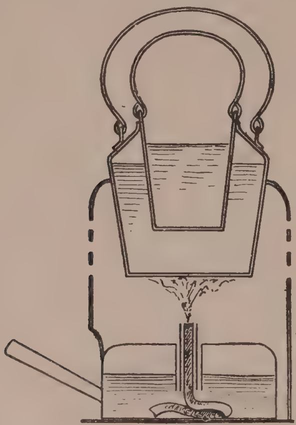


Fig. 5.—Spirit-heated Glue-pot

brushes are often used, but are apt to come undone. In any case, when the glue has set cold no attempt should be made to move the brush before thoroughly melting the glue into liquid again.

Glue brushes are sometimes made from a short piece of cane which is hammered out at one end, thus forming fibres or "bristles" (Fig. 3A).

Preparing Glue.—To prepare a pot of glue a cake must be broken up into small pieces, the smaller the better. The glue-pan should be about three-quarters filled with the glue, and water added to well cover, nearly filling the pan. The outer pot may be three parts filled with water, and with the glue-pan placed in it is boiled on the stove until the glue is dissolved. The more it is stirred the sooner it is ready; average time, within half an hour. The result should be a liquid resembling thin golden syrup. It can be thinned with water as required, and it is a common practice to use the hot water from the outer pot; but it should be clean. This water requires changing daily, otherwise it gets very rusty.

When the glue is boiled a white scum appears on the top. This is the impurity from the glue and should be removed with the glue stick.

A Patent Glue-pot.—Fig. 4 shows a patent glue-pot. It is not used for heating the glue, but for containing the glue after heating and keeping at as constant a temperature as possible; A represents the outside jacket; B is a layer of fabric keeping in position a layer of horsehair C. Between the inner and outer linings D and E is a space F to contain water. The inner glue-pot J fits so that a small annular space H is left for water; G is the filling nozzle.

A satisfactory makeshift glue-pot is provided by using a jam-jar or tin can in a saucepan of water.

Fig. 5 shows a spirit (methylated) heater for glue, and Fig. 6 a gas heater.

For preparing glue quickly, it can be obtained ready ground into powder form, 1 lb. to 1 pint of water for use as glue; 1 lb. to 1 gal. of water for use as size.

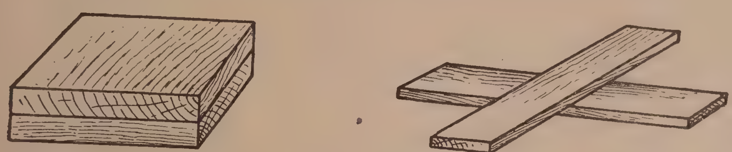
Another method is to have the cake glue always soaking in water to be partly ready for transferring to the glue-pots.

Fig. 6.—Gas-heated Glue-pot

Method of Gluing.—The quicker a joint can be properly glued and cramped up the better. The cramping tools should be set ready to hand, the glue quite hot and strong, but not stiff, inclining towards thinness than otherwise, and draughts of cold air avoided. The ends

of the dowels may be slightly pointed and the holes slightly countersunk, the more quickly to go together, and if very tight-fitting, to avoid air compression it is advisable to take a shaving off the dowels, making a slight flat to allow the air to escape, unless the grooved dowels are used for the purpose. Inside the holes, the dowels, and meeting surfaces of the joint have to be glued, and should be made warm before applying glue of the right consistency for each particular purpose. Soft or open-grain woods absorb the glue more than those that are hard and close, so it can be used slightly stiffer. In making a rubbed joint of two boards edge to edge of very hard wood, the glue must be sufficiently thin and hot to scald the wood fibres up to unite together. Hardwood glue-blocks and braces do not hold so well unless they are toothed.

Figs. 7 and 8.—Pieces Glued together "with the Grain"



Figs. 9 and 10.—Pieces Glued together with Grain at Right Angles

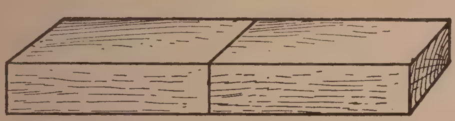


Fig. 11.—An End-grain Glued Joint

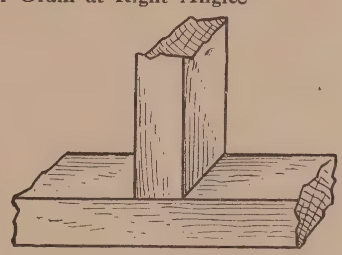


Fig. 12.—Glued Joint, One Piece with End Grain

the glue amply and cramping up as close as possible. The fibres of the wood will be compressed into each other and united by the glue. The surplus squeezed out can be taken off and wiped clean with a rag wrung out of the hot water, though it is often left until set to be cut off with a sharp chisel. A glued joint should not be disturbed till it is quite set.

In re-gluing a broken joint the old glue should be completely cleaned off.

Some judgment is necessary to have

For veneered work it is worth the cost to have a good brush of a size that will spread the glue quickly and evenly over the surface without shedding a hair. The glue can be made thinner than required and strained through muslin, then boiled to the right consistency; but if the surface to be veneered is very absorbent, a sizing coat of the thin glue may be given.

Glued Joints.—Glue is a satisfactory means of union when pieces of wood have to be united with their grain as in Figs. 7

and 8, but not with it at right angles as in Figs. 9 and 10. It is not impossible to make a good glue joint with grain at right angles, but in ordinary work it is not done, the reason being that shrink-

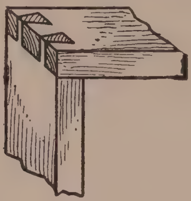


Fig. 13.—Glued Dovetail Joint

age of either piece will break the joint. But apart from shrinkage, such a joint as in Fig. 10, depending on glue alone, could easily be pulled apart. On the other hand, joints as in Figs. 7 and 8 would, if properly made with good glue and kept dry, be as strong as a solid piece. End-grain joints, either when both pieces are end grain as in Fig. 11, or when one only is end grain as in Fig. 12, are never glued, except in a few instances where the glue can be regarded merely as an auxiliary not to be trusted. When glue is used on end grain the surface should be sized with a first coat of glue, which is allowed to soak in and dry before the final gluing is done, otherwise the glue is absorbed into the pores and fails to hold the joint.

Although pieces crossing as in Fig. 10 would never be glued, it is the common practice to glue such joints as Figs. 13 and 14, where the parts have their grain at right angles, but fit tightly in themselves, and can therefore be held together by glue securely enough for most purposes. Nevertheless, even in these cases, glue alone is not relied on if additional means can be employed without detriment to the appearance of the work. Glue is often used in addition to nails or screws, and in such cases clamping is unnecessary. Really good glue joints, however, are often spoilt if nails or screws are put in, because the perfect contact which has been made in squeezing out the glue is broken by driving nails or screws immediately after.

The method of exerting pressure to keep the parts tightly together while the glue is drying depends on the shape and size of the work. In some cases a convenient way is to put a weight on the top piece of wood; in others, clamps of some kind are better, and in others staples driven in, wedges arranged to act as clamps, or string bound round the parts may be suitable. Fig. 15 shows how a staple or dog is used. Its inner edges being tapered draw the parts together. It makes holes in the wood, which are objectionable sometimes, but frequently are not. A wooden handscrew is often used to hold the pieces together. It is adjusted with its jaws over the work, not quite parallel but wider apart at the extremity than at the back, and then tightening the back screw closes the points of the jaws by leverage. Metal clamps of various kinds and sizes are used also. When the surface of the work is large the clamps are often not put on it direct; but pieces of wood are interposed to equalise the pressure over a larger surface than the clamp jaws would cover.

A thin piece of wood wetted by glue on one face naturally warps; that is, the moisture makes it swell and become con-

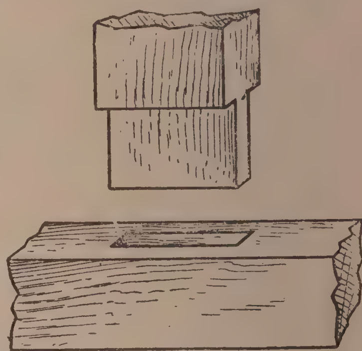


Fig. 14.—Mortise-and-tenon Joint, another Joint commonly Glued

vex on the wetted face and concave on the opposite one. If this is not prevented, the glue joint will open at the edges and remain so after the glue has set. If it is kept in close contact by pressure until

the glue is dry enough to hold it, the joint will remain close. If it is not easy to apply the required pressure, the warping can sometimes be counteracted by wetting the outer face with water. If only a small thin piece has to be glued on, it is sometimes best to use a thicker piece than is wanted, and reduce it after the glue is dry. This is always advisable when the glued-on piece has to be pared or planed down thin at any of the edges, for a thin edge easily curls up when wetted on one side. Thick pieces of wood are not affected in this way. Fine wire nails driven part way in diagonally at intervals, to be subsequently pulled out, are sometimes used for keeping edges close while glue is drying.

Waterproof and Other Special Glues.—Besides the glues already mentioned, there are many varieties used for special purposes. Fish glue is obtainable in tubes and bottles, and is useful for small jobs. Seccotine is a strong, handy glue, and can be recommended for small work.

A good liquid glue can be made by breaking glue and soaking the pieces in acetic acid. Slightly heat the glue and add more acid until the required consistency is obtained.

Marine glue is useful for cementing different kinds of materials as leather, iron, glass, wood, etc. It is best bought ready made; it contains about 1 part of rubber and 20 of shellac, incorporated through the medium of 12 parts of coal-

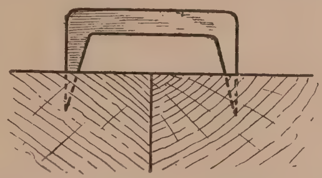


Fig. 15.—Use of Dog to hold Glued Work together

tar naphtha and evaporated to dryness. In using it should be warmed and applied sparingly.

Waterproof glue may be prepared by heating glue in the ordinary way and adding 1 part of bichromate of potash for every 2 parts of cake glue used; the glue thus prepared must be kept in the dark (say in a stone jar with a close-fitting lid) until required, because it becomes insoluble on exposure to light.

Procedure in making glued butt joints —work requiring some amount of craftsmanship for its successful accomplishment—is described in a later chapter.

Nailing, Screwing, and Bolting

THE parts of woodwork should, as far as possible, hold one another together. This is one of the chief secrets of the durability of old woodwork. The joints were fashioned so that they were interlocking, or so that they were held together by wooden pins. This method of making joints is expensive, and to-day nails, screws, bolts, glue and paint are used for fastening the parts of woodwork together. The suitability of each kind of fastening depends on the particular work.

Glue is used chiefly for internal work and furniture. Joinery, such as inside doors, cupboards, stairs, etc., are fastened together with glue and wedges. Windows and outside doors, which are subjected to damp, have the joints painted and wedged; the joints are also sometimes "pinned" with small pegs passing through the tenons.

Nails, generally speaking, are only used in inferior work or constructional carpentry. If used in good work the nails are kept out of sight.

Screws have a greater holding power than nails. They are therefore used where greater strength is desired, or where it may be required to pull the work to pieces at some future time. The chief method of fixing hinges and other ironwork is by means of screws. Bolts may be considered to be a special form of screw used where great security is desired. It is useful to remember that screws and bolts should be turned as the hands of a clock to tighten them up; the reverse to loosen.

Varieties of Nails.—There are many varieties of nails, as shown in Figs. 1 to 12. Probably the best nail for all-round purposes is the oval wire nail (Fig. 1). Because of being oval (really elliptical) in section it does not split the wood easily, and as its head is small it only leaves a small hole.

The oval nail does not hold as well as the round nail (Fig. 2), the head of the latter assisting to hold the wood as well as the friction on the shank. The head of the round nail is serrated or roughened to prevent the hammer slipping off the head when nailing. Oval nails may be obtained in the following sizes: $\frac{1}{2}$ in., $\frac{3}{4}$ in., 1 in., $1\frac{1}{4}$ in., $1\frac{1}{2}$ in., 2 in., $2\frac{1}{2}$ in., 3 in., 4 in., 5 in., and 6 in.

The shanks of both round and oval wire nails are roughened near the head so that they will hold better in the timber. Round nails are generally used for rough work. Wire nails, as the name implies, are cut from wire.

Floor brads, or cut nails (Fig. 5) are mostly used for nailing floor boards. The nails are made by simply punching them from a sheet of thin metal.

The wrought nail (Fig. 4) is very similar to the cut nail, but the shank tapers in both thickness and width, and the head is hammered to shape in manufacture. This nail is now little used.

The wire nails are of a bright colour, and the wrought or cut nails are dull.

The panel pin (Fig. 10) is a very handy type of nail, being really a very thin round wire nail with a small head. It

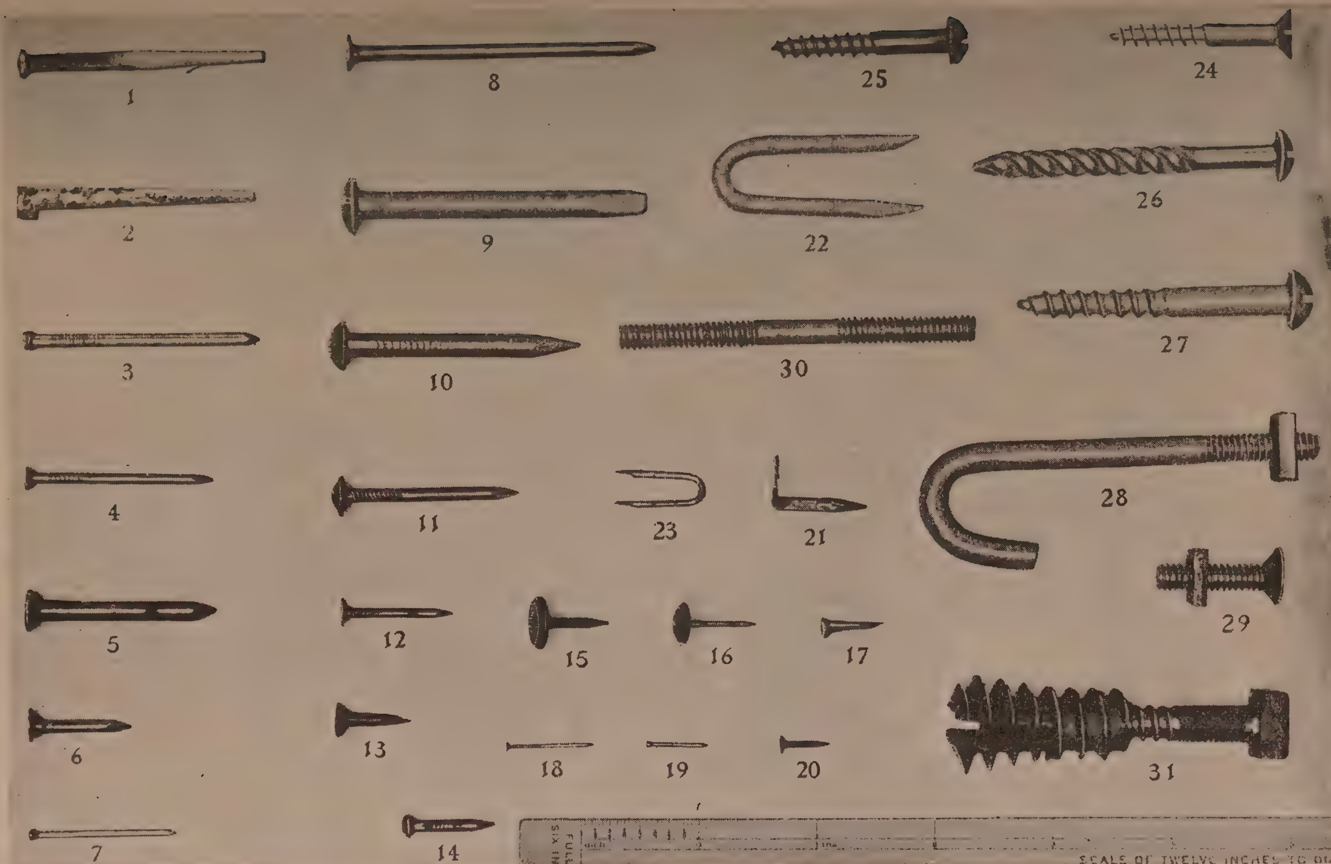


FIG. 1.—A GROUP OF NAILS, SCREWS, AND BOLTS,

1, Cut Nail; 2, Cut Brad or Floor Brad; 3, Oval Wire Nail; 4, Small Wire Nail; 5, Wall Nail; 6, Small Clout Nail; 7, Panel Pin; 8, Round Wire Nail; 9, Galvanised Chisel-pointed Roof Nail; 10, Bright Roofing Nail; 11, Brass-headed Nail; 12, Lath Nail; 13, Small Stout Tack; 14, Screw Nail; 15, Drugget Pin; 16, Chair Nail; 17, Tinned Tack; 18, "Cigar-box" Pin; 19, Small Pin; 20, Wire Gimp Pin; 21, Tenter Hook; 22, Fencing Staple; 23, Small Wire Staple; 24, Countersunk-head Wood Screw; 25, Round-head Wood Screw; 26, Bright Driving Screw-nail; 27, Galvanised Roofing Screw; 28, Galvanised Hook Bolt and Nut; 29, Small Bolt and Nut; 30, Double-ended Fixing Screw; 31, Expanding Wall-plug

is very useful for nailing beadings and other small work.

Needle points (Fig. 12) are simply needles

Fig. 2.—French or Wire Nail

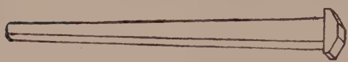


Fig. 3.—Cut Clasp Nail

Fig. 4.—Wrought Clasp Nail

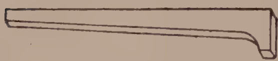


Fig. 5.—Cut Brad or Floor Brad

Fig. 6.—Rose-head Wrought Nail

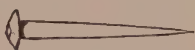


Fig. 7.—Pointed Rose-head Nail

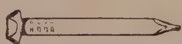


Fig. 8.—Oval Steel Nail

Fig. 9.—Town Clout-nail with Countersunk Head

Fig. 10.—Panel Pin

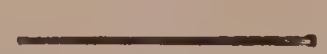


Fig. 11.—Veneer Pin

Fig. 12.—Needle Point

without the eye part. They are used for "nailing" very fine work. When a needle point has been driven as far as required into the wood a slight tap at the side breaks it off flush with the surface of the wood, and the needle point is practically invisible.

Clout nails are small round nails with large flat heads. This shape makes them very suitable for nailing roofing felt and similar materials.

Holding Power of Nails.—When a nail is driven into a piece of wood (Fig. 13) some of the fibres of the wood are broken and bent downwards, the ends of the fibres pressing against the sides of the nails; other fibres are pressed apart, and in the effort to maintain their normal course bind on the nail. These two forces hold the nail in the wood and prevent it being easily withdrawn. A nail does not hold as firmly when in the end grain of the wood.

If two pieces of timber are nailed together as in Fig. 14, the top piece is held to the nail by the friction on the sides of the nail plus the holding power of the head; the nail is only held in the lower piece by the friction on the sides. Nails should be used so that the holding power in each of the pieces of wood joined is about the same. The holding power of a nail is equal to the grip of the weakest side, just as the strength of a chain is the strength of the weakest link.

It follows that if a piece of wood $\frac{1}{2}$ in. thick has to be nailed to a thick piece of wood, then the length of the nail in the thick piece should be more than $\frac{1}{2}$ in. to make up for the holding power of the nail head on the other piece. If the nail is an oval wire nail having a small head, a suitable nail would be $1\frac{1}{4}$ in. long, but if the nail were of round wire with a large head, a $1\frac{1}{2}$-in. nail would be better. If the joint were as Fig. 15 with the nail going into the end grain, a suitable length for an oval nail would be $1\frac{1}{2}$ in., and for a round nail either $1\frac{1}{2}$ in. or 2 in.

If two pieces of equal thickness (as Fig. 16) have to be nailed together, it is obvious that, if nails that are just equal to the two thicknesses are used, the nails would pull out of the back piece fairly easily. Rather longer nails are

therefore sometimes used and "clinched" —that is, bent over—on the back side. Clinching may be done by bending the nails down with the hammer after they have been driven, or by nailing the pieces together on an iron plate. The latter, where it can conveniently be adopted, gives a quicker and better job, and avoids splitting on the back side.

(pine, spruce, red deal, etc.) can be nailed without fear of splitting, but even with these woods if the nails are near the end of the piece (say in making a box) it is sometimes advisable to "bore for the nails" with a bradawl.

Hard wood can seldom be nailed without boring. It is better to bore in case of uncertainty, but the hole should be less

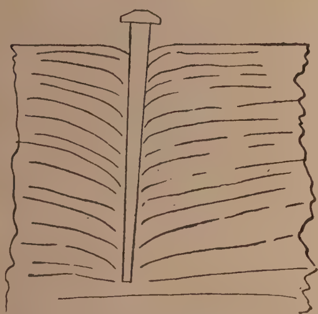


Fig. 13.—How Wood Fibres Grip a Nail

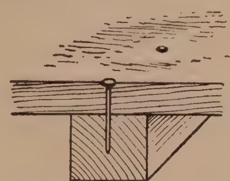


Fig. 14.

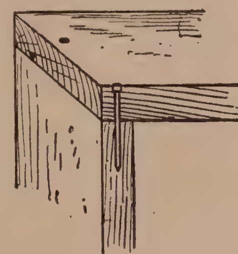


Fig. 15.

Fig. 16.—Clinched Nail

Figs. 14 and 15.—Holding Powers and Lengths of Nails

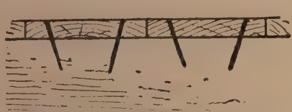


Fig. 17.—"Dovetailed" Nails

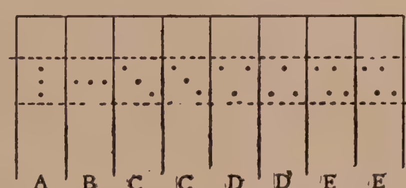


Fig. 18.—Various Methods of Nailing Boards to a Supporting Piece

Another method of making the nails hold better is to drive them on the slant as in Fig. 17. This is sometimes called "dovetailed nailing," and it is clear from the illustration that boards nailed in position in this manner cannot be as easily pulled apart as when the nails are driven parallel.

Preventing Splitting. — The chief difficulty that a beginner experiences in nailing is splitting the wood and thus spoiling the job. The trained craftsman knows from experience when the timber is likely to split.

Generally speaking, most soft woods

than the shank of the nail so as not to lessen appreciably its holding power. The thinner the nail and of course the less likelihood there is of splitting the wood.

In nailing boards or battens it is better to zig-zag the nails to avoid splitting and to give greater holding power. Fig. 18 shows various methods of nailing boards to a supporting piece; A is incorrect, as the nails would tend to split the board, and would not hold the boards to the bearer at the edges; B shows a rather better method, but this would tend to split the bearer; C and D show

correct methods; E shows an excellent method, using four nails to a board.

Nailing.—The actual operation of nailing is very simple, and expertness depends upon practice. One or two hints may, however, be useful. A common fault of the beginner is that he holds the hammer too stiffly and too near the head. Grip the hammer as near the end of the shaft as convenient and let it fall freely, hitting the object with a sharp rap. The amateur usually seems to retard the fall of the hammer just as it is hitting the nail, etc.

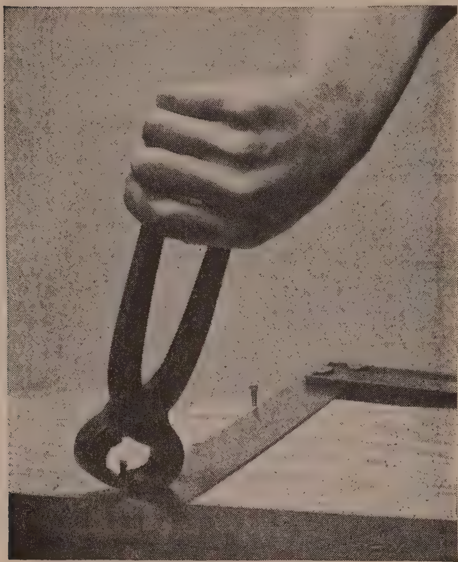


Fig. 19.—Using Blade of Square to obviate marking work when using Pincers

When driving nails there should be something substantial beneath or behind the work to receive the impact of the blows and prevent vibration. Thus, in a case where a nail has to be driven horizontally, with nothing for the work to bear against, it is a great advantage to hold a block of metal or another hammer against the opposite side. It is not the pressure which this exerts, but its resistance. Without it, and with the work only steadied by the left hand, the nail would require at least twice as many blows, and even then the parts might not be held so tightly together, besides which the vibration at each blow might have injurious effects elsewhere. Nailing on the bench should be done over one of the bench legs. Nailing on the ground should be done on solid ground rather than on a boarded floor.

Hammer Marks after nailing are the chief sign of the amateur. The hammer-head is ground slightly round, and if it only lightly hits the wood surface no mark is made. Care should be taken in driving nails, as hammer marks are difficult to remove. If the "dent" is wetted and left overnight it will have risen somewhat by the morning, and may be glasspapered level.

There is a good method of nailing mouldings, etc., to avoid hammer marks, by using the blade of a square under the nail and gliding the hammer on the blade of the square.

A common cause of hammer marks is that the "face" of the hammer becomes greasy and thus readily slips off the nail and hits the wood. In this case the hammer should be cleaned by simply rubbing on the floor.

Fig. 20.—Using Scrap of Wood as a Prizing Piece

Withdrawing Nails.—A nail has often to be withdrawn from timber, owing to the nail going crookedly into the wood,

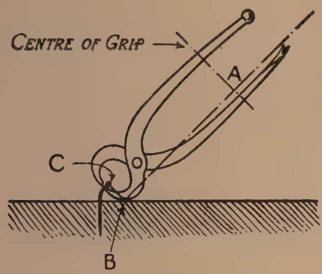


Fig. 21.—The Pincers as a Lever

or to bending due to the nail "catching" a knot or the wood being too hard. As soon as it is found that the nail is not "going" straight enough it should be pulled out, as the further it is driven in the more difficult it is to get out.

There are three tools used for withdrawing nails: the claw of a claw-hammer, a nail puller, or the pincers.

A pair of pincers is really a double lever. Firstly, by gripping the pincers tightly in the hands a good grip of the nail is obtained. If the nail has a large head this part of the operation is easy, but if the nail has no head it is difficult to keep a firm grip on the nail.

Secondly, keeping a firm grip on the pincers they are levered over with the

Fig. 22.—Round Nail-set or Nail-punch

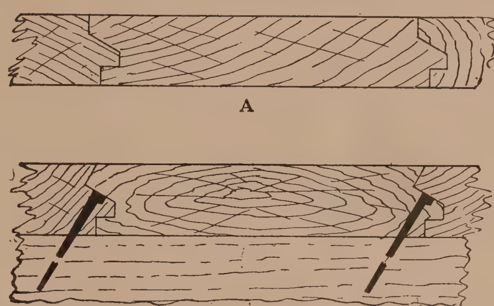
Fig. 23.

Fig. 24.

Figs. 23 and 24.—Square Nail-sets

jaw of the pincers pivoting on the surface of the wood. This operation is shown in the diagram (Fig. 21). The power of a pair of pincers depends on the proportion of length A B to the length B C. In the diagram A B is 6 in. and B C is 1 in.; the power or mechanical advantage of the pincers is, therefore, 6—that is, for every 1 lb. pressure put on the pincers there is a pull upwards on the nail of 6 lb. If, with the pincers of the proportions shown, it requires 50 lb. pressure to pull the nail out, then the nail has a holding power of 300 lb.

In pulling out a nail there is a danger of marking the wood with the pincers levering on the surface. This does not matter in rough work, but in good work it should be avoided by placing the blade of a try-square between the pincers and the wood surface as in Fig. 19. A bit



A

B

Fig. 25.—Secret Nailing applied to Floorboards

of wood is sometimes used instead of the blade of the try-square—also to give better purchase (*see* Fig. 20).

Punching.—In good work, nails are usually "punched" about $\frac{1}{8}$ in. below the surface of the wood. In painted work the nail holes are then filled with putty, and "stoppings" of various kinds, as will be described later, are used in varnished and polished work.

Three varieties of nail punches are shown in Figs. 22 to 24. The punches vary a little in shape, some being square and others round. A convenient shape of punch end is made by filing small flat surfaces on a round punch; this shape is useful, because it is very similar to the hole made by an oval nail.

Usually the punch has a flat end, but many are now made with a cup-shaped end so that the punch will not easily slip

off the nail. It is usual for a woodworker to have two (sometimes three) sizes of punches to suit various sizes of nails.

Secret Nailing.—In good-class work it is desirable not to have the heads of the nails in the face of the work even if filled in with a good stopping. Moulding should be nailed as much out of sight as possible. Floor boards are often secret-nailed through the tongue. Another method of secret nailing is to lift up a small splinter or shaving of wood with a narrow chisel, drive the nail, and then glue and press the shaving back into position. A special tool for lifting a shaving for this method of nailing is shown in Fig. 67 (page 99). Tongue-and-groove boarding is sometimes secret-nailed, a special form of this joint being shown at A and B (Fig. 25).

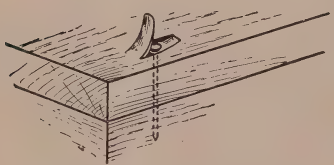


Fig. 26.—Secret Nailing

SCREWS AND SCREWING

Types and Sizes. — Wood screws are made of iron, brass, copper, and gun-metal, and are supplied with different shaped heads. The countersunk (Fig. 27) is the sort most often seen, and is used where a flush surface is required. The round head (Fig. 27A) is mainly used where the material is too thin to allow countersinking, but it is also employed for the sake of appearance, and the raised head (Fig. 27B) is a modified combination of both the former sorts. Other forms of head are made, such as cheese and ball shapes, but they are seldom required by woodworkers. In Figs. 27 to 27C, A denotes number and size, and B length.

A gutter or spout screw, shown in section in Fig. 28, is used for fixing ogee spouting to a facia board; it will be seen that there is an annular groove underneath the head; this is intended to hold a red-lead or other packing so as to make a watertight joint at the screwhole. Iron screws can be had blued, japanned, tinned, galvanised, and brassed or coppered finish; and screws made of brass or copper may be oxidised to match different colour bronzes, or nickelled, or silvered.

For use in hard wood, or in any situation where they may have to be withdrawn from time to time, countersunk screws are often provided with a cup or socket (Fig. 28A), which fits accurately under the head. This socket is ribbed on the outside that it may not turn in the wood; its office is to enable the screw to be extracted without trouble and without marking the wood surface.

The thickness of screws is measured by a gauge on which (unlike the wire gauge)

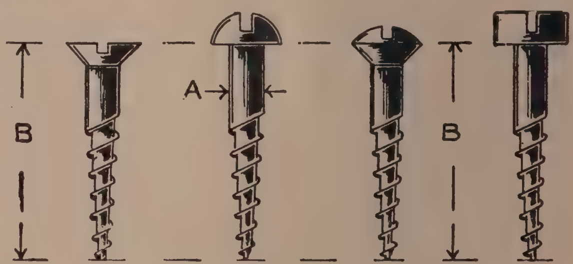


Fig. 27.—Countersunk-head Screw

Fig. 27A.—Round-head Screw

Fig. 27B.—Raised-head Screw

Fig. 27C.—Cheese-head Screw

the higher the number the larger is the diameter of the screw (see table in first column of page 15).

Japanned round-head screws are largely used for thumb latches, barrel bolts and rim locks; the most useful sizes are $\frac{3}{4}$ in. by 8, 9; 1 in. by 9, 10; $1\frac{1}{4}$ in. by 10; $1\frac{3}{4}$ in. by 11; and 2 in. by 12.

A useful range of sizes of brass screws with countersunk heads would be $\frac{1}{2}$ in. by 4; $\frac{5}{8}$ in. by 5, 6; $\frac{3}{4}$ in. by 6, 7, 8; 1 in. by 7, 8, 9; $1\frac{1}{4}$ in. by 8, 9, 10; $1\frac{1}{2}$ in. by 10, 11; 2 in. by 11, 12.

Handrail screws (Fig. 29) are made with parallel and with swelled centres; they are used for jointing up sections of wood handrail. They have a square nut at one end and a round nut at the other, the

latter nicked around its periphery so that it may be tightened up when in position by a small chisel; the object of the swelled centre is to fill the hole in the wood rail tightly, and so prevent

Fig. 28.—Gutter or Spout Screw

Fig. 28A.—Screwhead Cup or Socket

any slackness at the junction. Dowel screws (Fig. 30) are, as the name implies, used for dowelling up two pieces of wood; they are used amongst other purposes for fixing ornamental ends on curtain poles.

Corrugated fasteners (Fig. 31) are pieces of steel having a chisel edge on one side and are corrugated in section; the corrugations are not parallel, but inclined towards each other at the top so that when they are driven across the joint between two pieces of wood they have a tendency to bring the two edges closer together.

Screws made by different British firms are sufficiently alike in gauge for the accompanying table—which has been calculated from data supplied by the leading makers—to be relied on:—

Number or size of screw	1	2	3	4	5
Diam. of shank in parts of an in.	.066	.080	.094	.108	.122

6	7	8	9	10	11	12	13
.136	.150	.164	.178	.192	.206	.220	.234
14	15	16	17	18	19	20	21
.248	.262	.276	.290	.304	.318	.332	.346
22	23	24	25	26	27	28	29
.360	.374	388	.402	.416	.430	.444	.458
30	31	32					
.472	.486	.500					

The range from one size to the next is .014 in., and in the absence of a table the following easily-remembered formula will enable the diameter of any desired size to be ascertained: Diameter $= (.014 \times \text{No.}) + .052$ in. For example, $(.014 \times 16) + .052 = .224 + .052 = .276$ in. = diameter of No. 16 screw, and $(.014 \times 32) + .052 = .448 + .052 = .5$-in. diameter of No. 32.

The diameter of the head is twice that of the neck or shank.

Numerous lengths are obtainable in each size from $\frac{1}{4}$ in. upwards in the smaller sizes up to 9 in. in No. 32. Larger sizes can be obtained to order, but are not stocked or gauged.

The length of a wood screw is the distance from the point to the portion normally flush with the surface of the material into which it is driven. Dowel screws are measured from point to point.

Boring for Screws.—Screws are used in cases where work may have to be taken

Fig. 30.—Dowel Screw

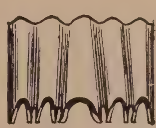


Fig. 31.—Corrugated Fastener

Fig. 29.—Handrail Screw

apart again and where a very secure hold is necessary accompanied also with the means of gradual tightening. In some cases the avoidance of the shock of nailing is an advantage. In the attachment of metal to wood, nails are usually quite unsuitable, as the tightness of their hold cannot be adjusted or relied on.

Holes are almost invariably bored for screws. This is because it is undesirable to have the smooth parallel part of the screw a very tight fit in the wood, as it may prevent the joint from closing per-

fectly. Fig. 32 shows two pieces of wood screwed together, the screw shank fitting loosely into the top piece. A hole for a screw is bored completely

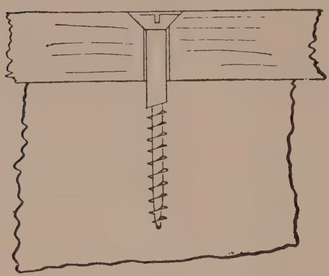


Fig. 32.—Diagram Showing Cramping Action of Screw Properly Inserted

through the first piece of wood, and may or may not be continued into the second piece, depending on the size of the screw. The screw thread cuts its own way, and the hole it enters must be smaller in diameter, and may be shorter than the distance to which the screw will penetrate. The hole must be bored relatively larger in hard wood than in soft. Fig. 33 shows at A a screw inserted in the ordinary way, and at B a deeply countersunk screw, C and D show respectively the way the holes are bored for these, though in the first instance screws are often put in without making the shallow countersink shown at C, the screw simply being

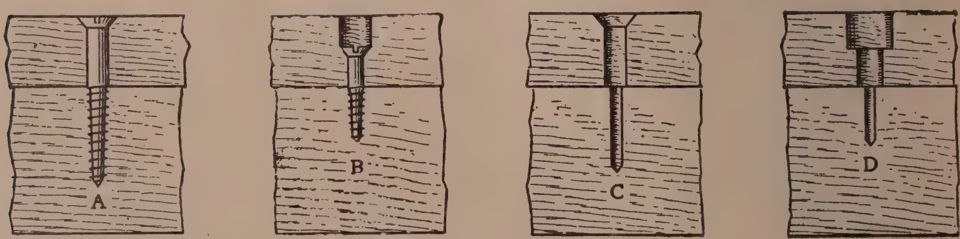


Fig. 33.—Boring for Various Screws

tightened until it has forced its way flush.

A shell bit (illustrated later), fixed in a brace, is generally used for boring screw holes. Sometimes a gimlet is more convenient, but is much slower and rather more liable to split the wood. The holes are bored completely through the first piece of wood before it is adjusted on the

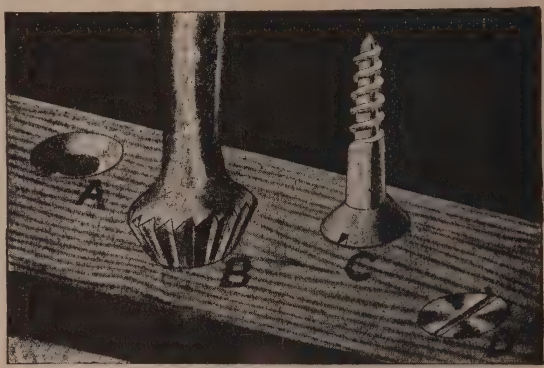


Fig. 34.—Countersinking for Screw Heads

second, and any projecting splinters or burr on the joint surface are removed with a chisel before the joint is closed. Then the smaller holes in the second piece are made with a bradawl or gimlet or bit passing through the upper and larger holes. If the wood is soft and the screws small, no holes are bored in the second, but the screws are started and steadied by a tap with a hammer, and are run in with a screwdriver or screwdriver-bit in a brace, the latter being preferable when a large number of screws are being inserted. The small handdrill on a later page is very convenient for boring screw holes. Screws are sometimes greased before insertion to prevent rusting and to make them turn easier.

Countersinking.—The reason for countersinking is generally to get the heads well below the surface; but if a hole is

not countersunk, the screw head in forcing its way level will twist and break the fibres of the wood more or less around the head, and, except in rough work, the appearance of this is objectionable.

Countersinking is done with the brace and bit as shown by Fig. 35, or with a gouge or chisel, as in Figs. 36 and 37. The countersinking is effected by beginning with the chisel at one side of the hole and twisting it so that it scoops out the countersink. The bit-and-brace method is neater and quicker. Fig. 34

Fig. 35.—Countersinking with Brace and Bit

A shows a hole countersunk with a brace bit; B shows the bit; C shows the screw, and D shows the screw in position. A deep countersink as at B and D (Fig. 33) is made with a centre-bit before the hole for the body of the screw is bored. The reason for a deep countersink may be to avoid using extremely long screws, but frequently it is to allow the holes to be plugged with wood after the screws are in, the grain of the plugs usually running the same way as that of the plugged surface. Fig. 38 shows a wood plug being inserted in a screw hole. The plug is driven in as far as possible and then cleaned off level with the surface.

In screwing parts together a side pull as well as a direct squeezing together of

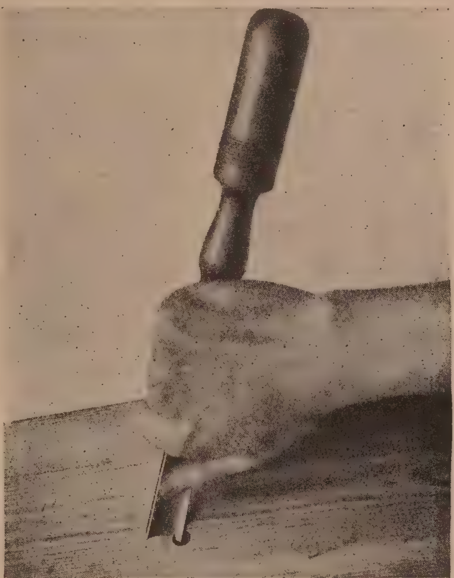


Fig. 36.

Fig. 37.

Figs. 36 and 37.—Countersinking with Gouge and Chisel respectively

the joint can be exercised when desirable. This is done by boring the small hole in the second or under piece of wood out of centre in relation to the upper hole, as in Fig. 39. The screw then tends to

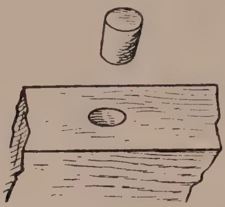


Fig. 38.—Wood Plug for Screw Hole

pull the holes concentric, and strains the parts in the direction desired. The reason for doing this is to pull a shoulder, as in Fig. 39, into the closest possible contact. With the holes concentric it might be slack or slightly open.

Spacing of Screws.—The positions and distances apart of screws require some judgment to decide. The rule, both with screws and nails, is that they should be much farther apart when arranged in a line with the grain than in a line across the grain, as illustrated at E (Fig. 40). This is because a row of screws very close together in the line of the grain might split the work, and because the wood being so much weaker across the grain than lengthwise needs to be attached at a greater number of points.

Points of attachment are more neces-

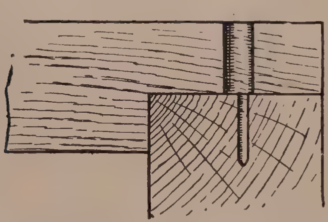


Fig. 39.—Method of Pulling Shoulder into Close Contact by Eccentric Boring

sary near edges than in the middle parts of large areas. F, G, H, and J (Fig. 40) show various arrangements of screw holes in strips or battens which have to be screwed to a surface. F is so narrow that the holes must be central. G has the holes arranged diagonally, the idea being that when screwed to a surface with the grain at right angles the screws would be about equally spaced across the grain in the latter surface, and so would hold it better, and no two screws would come in line in that grain. This has the disadvantage of an irregular appearance in the narrow piece, and also that two of its corners are not held uniformly with the other two ; but sometimes the screws at the corners are made uniform, and the diagonal arrangement limited to the

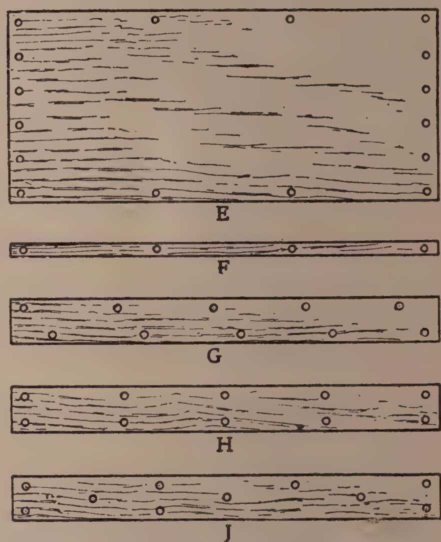


Fig. 40.—Screwing on Strips, Battens, etc.

intermediate ones, this also having an unsymmetrical appearance.

In a moderately wide strip the arrangement at H would generally be preferred, and in a still wider strip the arrangement at J is a good one. Fig. 41 shows arrangements of screws in members crossing each other. These would be equally applicable for nails, bolts, and screws. Where a single point of union is sufficient it would be central as at A. The next stage is to use two at opposite corners as at B. After this, four as at C or five as at D would follow, depending on the size of the work and the strength required. In the arrangement at E one member is

wider than the other, and the points of attachment are modified to suit. At F the members are not at right angles, and therefore with two points of union the screws would be inserted at the corners farthest apart.

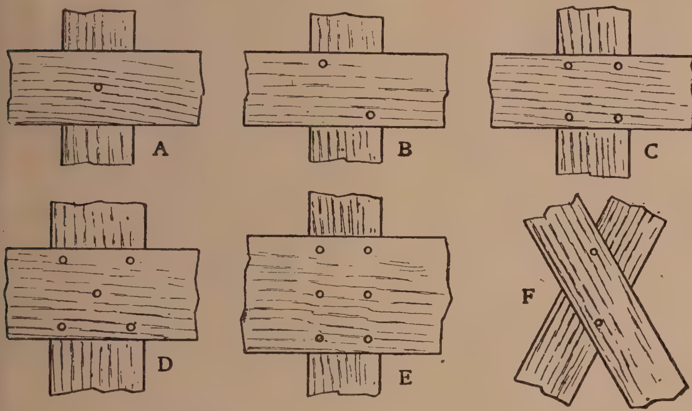


Fig. 41.—Screwing on Cross Pieces

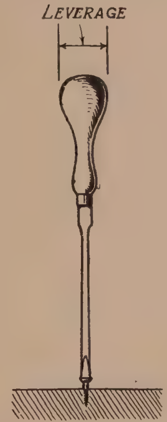


Fig. 42.—Action of Screwdriver

When a number of screw holes have to be bored their positions are usually marked with pencil first as some guide to symmetrical spacing. Occasionally the distances apart are equalised by measurement, but generally the workman trusts to his eye. Sometimes screws have to be inserted behind or beneath, while the pieces in front are held or temporarily secured in place by other means. These other means may be clamps or fine nails or bradawls, the two latter being put in diagonally at the edges of the piece, and pulled out after it has been screwed. They are used not so much to hold the parts together securely, as to prevent side movement while the screws are being inserted. Slight adjustments can, if necessary, be made with a hammer before all the screws are in and before the final tightening of any of them.

The Action of a Screwdriver.—A screwdriver may be described as a lever for turning screws. When the thread of the screw has got a hold in the fibres of the timber the turning of the screw causes it to worm its way into the wood, this action being largely helped by the gimlet point of the screw.

Fig. 42 shows a screwdriver; the theoretical power of the lever action will be proportional to the breadth of the handle—the broader the handle, the more powerful the screwdriver. In practice, however, the difficult part of screwing is not turning the screwdriver, but

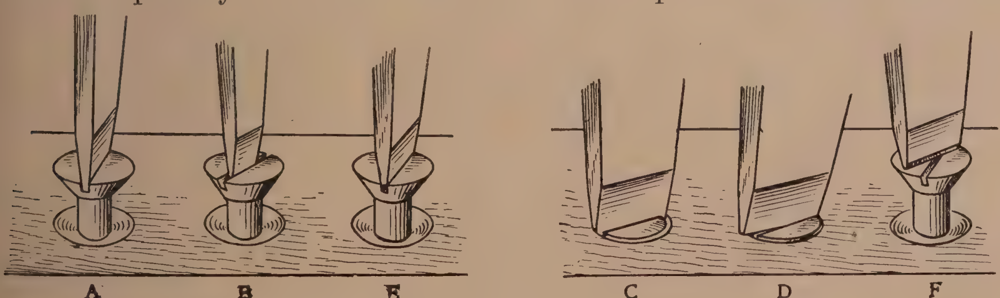


Fig. 43.—Width of Screwdriver Edge in relation to its work

holding the end of the screwdriver in the slot of the screw. When a screw has been driven the slot should be as perfect as before use. A badly damaged slot in a

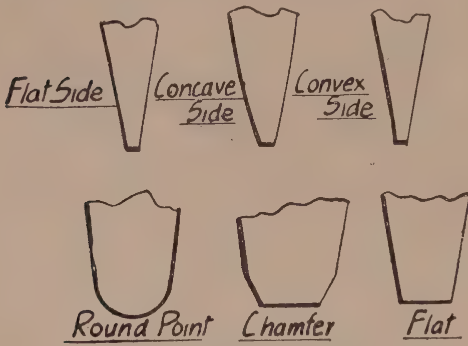


Fig. 44.—Screwdriver Edges

screw is the "hall-mark" of the amateur. Too great stress cannot be laid on this point. Once let the screwdriver slip off the head and the screw is more difficult to drive and more difficult to pull out, besides being evidence of inexpert workmanship.

To prevent the screwdriver slipping off the head of the screw it is necessary to hold the screwdriver tightly against the screw, paying more attention to this point than to turning the screwdriver. The edge of the screwdriver should fit the screw, as at A (Fig. 43). The edge should not be too narrow (as B) or too wide (as C). In the latter case the edges of the screwdriver tear up the edges of the timber unless the screwdriver is canted as D. The edge should not be filed as E, or it will be liable to jump out of the slot as in F.

In order to obtain as much leverage as possible with the screwdriver, there must be, as already explained, as much contact as possible within the slot in the screw head. It is thought that very few workers grind their screwdrivers correctly. The correctly-ground screwdriver has flat sides and a flat point, as shown in Fig. 44. The others shown are incorrect. More often than not it is the fault of the screwdriver that a screw cannot be extracted.

When the point of a screwdriver is round or chamfered, or if the sides are convex or concave, the torsion or twist of the hand merely tends to lift the end from the slot.

Fig. 44A shows how to hold the screwdriver on the emery-wheel or grindstone.

Generally speaking, a long screwdriver is better than a short one. The reason for this is somewhat obscure, as, theoretically, the nearer the pressure is to the screw, the easier should the screw revolve. It is contended, however, that it is impossible to hold a screwdriver perfectly upright, and the slightest inclination is bound to have a lever effect on the screw. Hence it is quite clear that the longer the lever is, the easier will the screw move.

Types of Screwdrivers.—The ordinary types of screwdriver is shown in Fig. 45. Some screwdrivers have round spindles with the end only ground flat; there are various shapes of handles.

The chief difficulty about using a screwdriver (with one hand) is to keep a pressure maintained on the screw and yet to glide the hand round the handle to turn it round. This difficulty is obviated in the case of the ratchet screwdriver (Fig. 46), a tight grip on the handle being maintained and the handle turned backwards and forwards, the ratchet letting

Fig. 44A.—Grinding a Screwdriver

the handle slip round on the backward turns.

The spiral screwdriver is shown in Fig. 47. Pressure on the top causes the spindle and screw to revolve. To drive screws by this method it is only necessary to press the screwdriver on the screw.

This is obviously a quick and easy method and very useful where a lot of small screws have to be driven. It is not very suitable for a large screw, as the point tends to fly out of the slot of the screw.

The brace and screwdriver bit is a quick method, and is particularly suitable when large screws are being used. With this method a great leverage can be easily exerted and the difficulty is to keep the bit in the screw slot. Where possible,

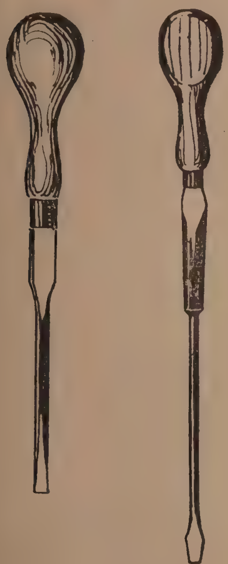


Fig. 45.—Two Screw-drivers

Fig. 47.—Spiral or Automatic Screwdriver

Fig. 46.—Ratchet Screwdriver

put the weight of the body on the brace. It will be found better to use the ratchet (on the brace) and only sweep the brace handle backwards and forwards through a quarter of a turn. If the brace is used horizontally, press the handle up and down through a quarter turn. More power can be exerted on the screw in this manner.

A woodworker usually possesses two or three screwdrivers of various sizes to suit different sizes of screws.

Withdrawing Screws.—A screw is usually more difficult to withdraw than to drive owing to the wood fibres having "set" round it, or the screw having rusted, or to the screw slot being filled with paint, varnish, etc. The usual way of "starting" a difficult screw is to place the screwdriver in position and then rap it smartly with the hammer. This will loosen the rust on the fibres and drive the screwdriver well into the screw slot. Try to avoid the screwdriver slipping, because once it slips out of the slot it will slip out easier the next time.

If the above method fails put a few drops of paraffin on the screw, which will tend to loosen the rust. A redhot poker pressed against the head of the screw will often cause the wood fibres to shrink a little and loosen the screw.

Fig. 48.—Coach Screw

Screws are often damaged whilst being inserted, a frequent happening being that one side of the screw head comes off. The screw should at once be turned back either with the screwdriver or pincers. If a screw happens to break off close to the surface of the wood so that the pincers cannot get a grip, it might be necessary to punch the screw right into the wood with a nail punch and then "peg" the hole up. The damaged screw could perhaps be removed by boring round it with a shell bit, the bit being a little larger than the shank of the screw.

Coach Screws.—A coach screw (Fig. 48) is like an ordinary screw but with a square head that can be turned with a wrench. They are generally of a larger size than ordinary screws, and are mostly used for rough or temporary work.

BOLTS AND BOLTING

Bolts are made with various shapes of heads and nuts, the commonest type having a cup head (round or snap head) and a square nut, as in Fig. 49 Other

types are shown in Fig. 50 to Fig. 56. The cheese-head has little projection and does not interfere with other parts of the work. The countersunk head is used vent it from "eating" into the wood. A washer under the head is also sometimes used, but this is not essential. Holes for bolts up to $\frac{3}{8}$ in. diameter may be bored


Fig. 49.—Cup-head Bolt


Fig. 50.—Square-head Bolt

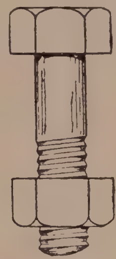


Fig. 51.—Hexagon-head Bolt


Fig. 52.—Cheese-head Bolt

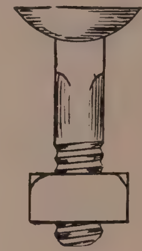


Fig. 53.—Countersunk-head Bolt

where the bolt head has to finish flush with the surface.

Bolts are made in many lengths and thicknesses, ranging from 1 in. to 12 in. long. Bolts for woodwork are usually made with a square shank just under the head; this prevents the bolt turning when the nut is being tightened up.

Holes for bolts should be bored so that with a shell bit; over that diameter it is better to use a twist bit.

It will be noticed that the nut has its edges slightly rounded on one side. Where the nuts are not seen it is better to use the rounded edges near the work as this gives an easier turning movement. Where the nuts are seen the rounded corners may be placed outermost to give


Fig. 54.—Long Square Bolt


Fig. 55.—Bed Screw


Fig. 56.—Billiard Bolt


Fig. 58.—Small Bolt for Gutters, Corrugated Iron, etc.


Fig. 59.—Holding Nut while Tightening Screw in Fixing Corrugated Iron


Fig. 57.—Winged Nut

the bolt will go in easily; the gripping power of a bolt is obtained by the pull between the head and the nut. Washers are generally used under the nut to pre- a better appearance, and to be more convenient for passing traffic, etc.

Office desks, etc., that have to be constructed in such a manner that they may

be taken apart for removal, are sometimes fixed together by bed-screws (Fig. 55) or billiard bolts (Fig. 56). The heads are sunk in the woodwork, and are usually covered by turned wood bosses fitting tightly into the circular hole which accommodates the head of the bolt. The former are screwed up by an old-fashioned bed-key, the latter by a strong turnscrew. The winged nut (Fig. 57) is used in connection with ordinary bolts for more temporary work, which has to be constantly taken to pieces and re-erected, such as market stalls, adjustable fittings, and furniture of various kinds; they are easily tightened or released by the fingers without the help of tools.

Bolts and nuts are measured in the hardware trade as from under head to point, but if it is remembered that the thickness of the nut equals the diameter of the bolt it is easy to conform to the manufacturer's system of measurement; thus a bolt required to pass through 9 in. of material, if desired to be of ½ in. diameter, must be 9½ in. long, if of 1 in. diameter must be 10 in. long, although, of course, when bolts are particularly ordered 9 in. *between head and nut*, the correct size would be supplied, but the order would need to be exactly worded.

Small bolts, as in Fig. 58, are used for fastening gutters, corrugated iron, etc., and Fig. 59 shows how the nut is held while the screw is driven tight.

Chamfering, Bevelling and Rounding

A CHAMFER means the removal or breaking of an angle, as in Fig. 1, by planing a narrow flat at, say, an angle of 45 deg. with the main surfaces. It is done to improve the appearance of the work, or occasionally to diminish risk of damage to sharp corners of wood. A chamfer is the simplest and quickest way of doing this. In rough work neither exact angle nor width of chamfer is taken account of, the workman judging by his eye alone.

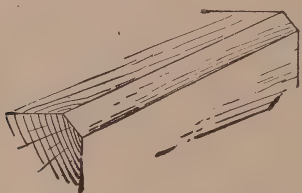


Fig. 1.—Chamfer

The work is done with a jack or smoothing or small iron plane, or with a chamfer plane.

A chamfer may run entirely round an outer edge, as in Fig. 2, but it is more frequently used on the inner edges of panelled framework, as in Fig. 3, and in the latter case the chamfers are almost invariably stopped, as shown, a short distance before they reach the corners.

The four common forms of "stop" are shown at A, B, C and D in Fig. 4, A being a curve dying into the straight, and B a flat angular stop. The stop at C is a variation of B, a small face being left at right angles to the chamfer; D is an ornamental stop consisting of a small semi-circular projection left on the chamfer adjoining, or a little distance away

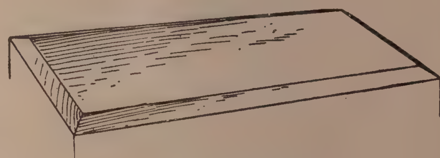


Fig. 2.—Chamfered Surface

from, the stop. A chisel is used to produce the stops, and is used flat on the surface, as in Fig. 5, for the flat stop, and the reverse way, as in Fig. 6, for the curved stop. A special template, somewhat similar to a mitre template, is sometimes used for cutting stops.

Chamfer planes (a metal chamfer plane is shown in Fig. 7) are useful when a great deal of chamfering is being continu-

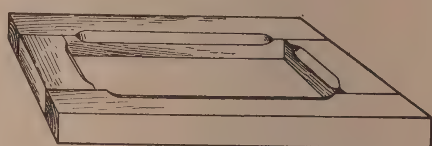


Fig. 3.—Chamfered Framing

ally done, but for occasional work they can very well be dispensed with. Their principle is that of a sole, Fig. 7A, which

fits over the right angle of the work to be chamfered, and a cutter adjustable for depth, so fixing the width and angle of the chamfer automatically. Adjust-

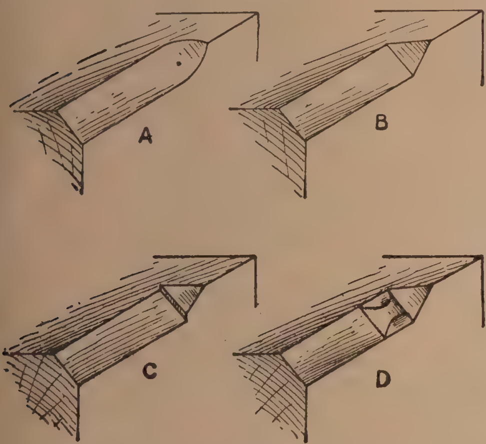


Fig. 4.—Various Forms of Stops for Chamfers

ments for different widths of chamfer are made either by raising or lowering the cutter or by moving the sides of the plane in relation to each other, according to the type of plane. Some are made in spokeshave form. These can be used for curved chamfers.

Another advantage possessed by chamfer planes is that they will cut right up to the end of a stop chamfer. An ordinary

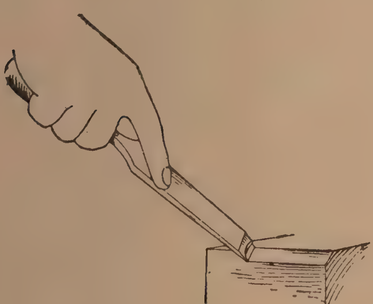


Fig. 5.—Cutting Flat Stop

Fig. 7A.—End View of Chamfer Plane

Fig. 6.—Cutting Curved Stop

plane with a front extending some distance beyond its cutter could not do this, but could either only be used on non-stopped chamfers, like those in Figs. 1 and 2, or would only work as far as the cutter would go towards the stop, the rest being finished with a chisel or spokeshave or a bullnose plane. The latter is shown in use on a chamfer in Fig. 8.

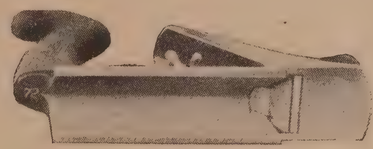


Fig. 7.—Chamfer Plane

It is an open-sided metal plane from about $3\frac{1}{2}$ in. to $7\frac{1}{2}$ in. long, with a cutter about $1\frac{1}{4}$ in. wide. It is, of course, used for much other work besides planing chamfers. Its front extends only $\frac{1}{4}$ in. or $\frac{3}{8}$ in. beyond the cutting edge, and this enables it to plane within that distance of a stop or shoulder on the work in front of the plane. Another type of plane, useful for stop-chamfering because it can be worked right up to the stop, is shown in Fig. 55, page 97.

When a chamfer plane is not used and a reasonable degree of accuracy is desired it is necessary to mark lines to plane to. In other circumstances a gauge would be the proper tool to mark them with, but lines cut into the surface at each edge of the chamfer could not be properly removed and would show more or less after the work was finished. Therefore pencil lines are preferred, which even if

not planed out can be obliterated in glasspapering.

If the chamfer is at the angle of 45 deg. these lines would be at an equal distance

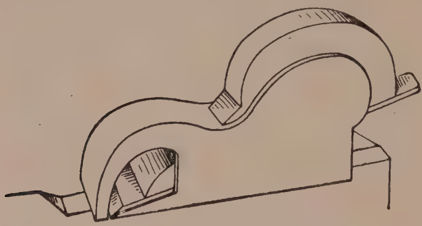


Fig. 8.—Using Bullnose Plane

from the edge of the wood, the distance depending on the width of chamfer desired. If not at 45 deg. one would be at a greater distance than the other. A pencil line may be gauged by notching a piece of wood to the required distance and drawing it along the work with a pencil held against it, as in Fig. 9; or the pencil can be held and drawn along with only the finger to keep it at uniform distance (Fig. 10). Lines could, of course, be measured and ruled if preferred.

As chamfers in ordinary work seldom

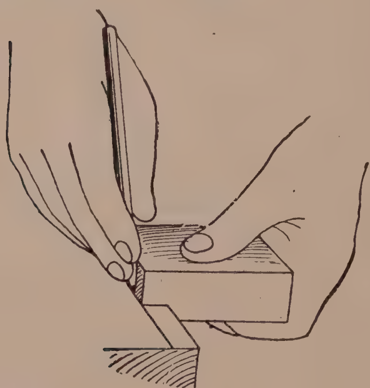


Fig. 9.—Drawing Lines for Chamfering, using Chamfering Gauge

exceed ½ in. in width a drawknife is not often employed, but the first rough cut is made with a chisel when a plane is considered too slow. More or less chisel work is always necessary in finishing the ends of stop chamfers. On end grain most, or even all, the material may be removed with a chisel, as in Fig. 11, though in most cases a plane would be used for finishing. The majority of chamfers run with the grain, the chief exceptions being the ends of a block of wood, as in Fig. 2.

Instead of a plain flat angle, chamfers are sometimes made more ornamental by beading or moulding them, as in Fig. 12. This has to be done with special planes or attachments to chamfer planes.

Occasionally curved work, either concave or convex, is chamfered, and then, of course, the chamfers follow the curve.

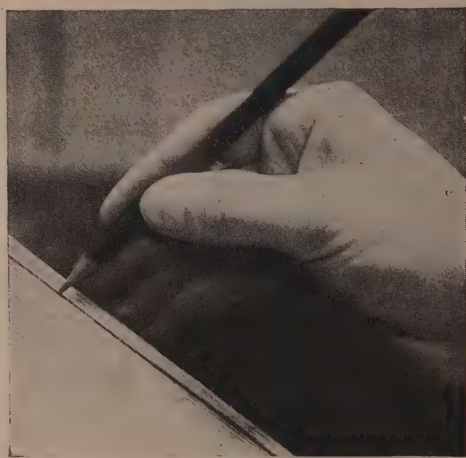


Fig. 10.—Drawing Lines for Chamfering, using Finger as a Guide

A flat plane cannot be used in such cases, but a spokeshave is the usual tool to employ, as in Fig. 13. It must be used in a direction which will not tear up the grain.

Bevelling.—Bevelling means the planing or chiselling of surfaces which are not at right angles with each other. A chamfer, of course, is an instance, but it is not called a bevel, because it is merely an ornamental detail. A bevelled surface is usually of equal importance with other main surfaces of the work and is not adopted for ornament. It may be necessary in forming a joint, or the shape of

the work may require it. It may be at the angle of 45 deg., which is sometimes distinguished by being called a mitre

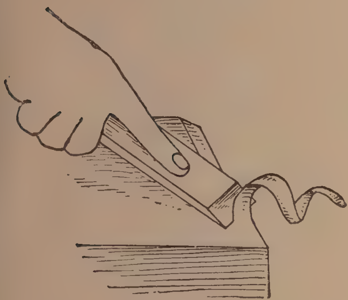


Fig. 11.—Chiselling Chamfer at End of Wood

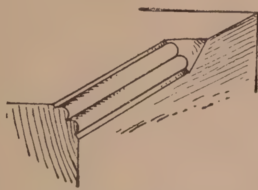


Fig. 12.—Ornamental Chamfer

or it may be at any other angle. Lines may be marked for working to, or an instrument called a bevel is set to the required angle and used for testing as the work proceeds. Fig. 14 shows such a test being made on an edge which is bevelled in relation to the faces of the work. It is generally easier and more accurate to use a bevel in such a case than to mark lines for planing to. Fig. 15 is an instance where the lines would be marked on the work even if a bevel was used for testing the angles afterwards. It represents octagonal blocks marked out ready for cutting. The bevel is used both for marking lines with and for testing.

Fig. 16 shows a more complex system of bevels; in fact, the right angles which are the general rule in woodwork are entirely absent. The angles in this case cannot be obtained from a protractor, as they are in most work. Generally in ordinary work a certain angle, perhaps 45 deg., is wanted and the bevel can be set to it on a protractor or on a set square of that angle, or it can be easily obtained by direct marking out. In a case like Fig. 16 the angles themselves are usually not specified, but only the dimensions of the article are known. The splayed tray or box must be a certain size at the top and a certain size at the bottom and a certain depth. This must be marked out full size in front view and end view on a sheet of paper or a board, and the bevel can be set to the angles thus obtained and

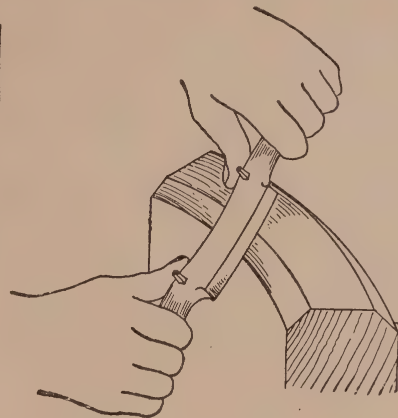


Fig. 13.—Using Spokeshave to Curved Chamfer

used in preparing the pieces of wood, measurement and bevel tests being equally important in the process. (The bevels to which the joints have to be sawn cannot be obtained directly from the front or end views, but must be obtained geometrically, as will be described later.)

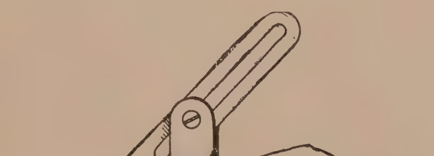


Fig. 14.—Testing Edge with Bevel

Mitreing, or fitting parts at the angle of 45 deg., occurs so frequently that there are a number of tools and appliances

specially designed for that angle, as will be explained in a later chapter.

Rounding.—Angles may be rounded instead of chamfered. Rounding also

Fig. 15.—Marking Octagonal Blocks

includes larger curvatures and may be done for other reasons than improved appearance. Rounding is usually done with flat cutters, such as ordinary planes, chisels or spokeshaves. There is a class of planes made for the purpose, usually kept in pairs and termed "hollows" and "rounds" (*see* Fig. 42, page 95). With them, rounding is done with a concave cutter and sole of a certain radius. It can be used also on quicker radii than its own but not on flatter curves, just as a gouge or round soled plane is useful on any curve of larger radii than its own.

An ordinary flat plane can be used on any convex curve which is straight in the direction of planing. If the latter direction is curved a spokeshave is used. Rounded surfaces, unless they are turned in a lathe, require more glasspapering than flat ones, because the cutting tools used, are usually flat instead of fitting the curve, and the latter becomes really a

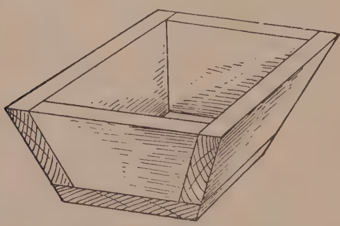


Fig. 16.—Splayed Box

series of narrow flats, the ridges of which must be removed by glasspapering.

There is some variety in the forms of rounded angles. A corner with square edges may be cut to a radius, as in Fig. 16A. An end may have one of its angles rounded,

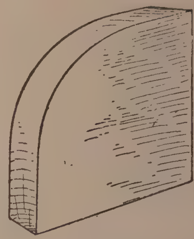


Fig. 16A.—Rounded Edge

as in Fig. 17, leaving the others square, or the rounding may be continued as in Figs. 18 and 19. An edge may be semi-circular, as at A, Fig. 20, or have small radii at the edges with flat between, as at B. Pieces of this cross-section may be curved lengthwise in addition to the transverse curve. The corner of a table, for instance, may be a quarter circle in plan and a semicircle the other way, and the quarter circle may be of any radius within reason, from a corner which might almost be glasspapered or rasped off, to a considerable sweep which would necessitate the use of a saw.

Except for very small radii dividers or compasses are used to strike the curves for the cutting tools to work to. Where this cannot be done, or sometimes in addition to this, a template is made for testing the accuracy of the radius as the work proceeds. The template is either a quarter circle or half circle, as in Fig. 21, and may be of thin wood or card.

Fig. 17.—Rounded Corner

A rounding along the edge of a piece of wood with the grain is easily planed. If of large radius it may first be roughed

with a drawknife or chisel, or even with a hatchet. When the curve is large and end grain is involved, as in Fig. 16A, a saw is used in the first place. A keyhole

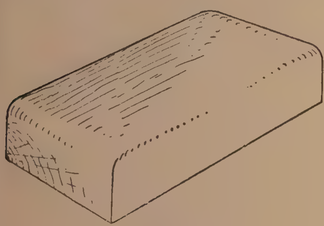


Fig. 18.

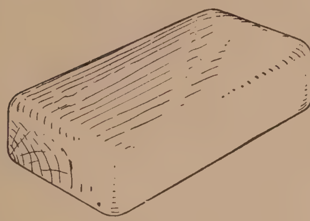


Fig. 19.

Figs. 18 and 19.—Rounded Corners

saw or bow saw may be run round the curve just clear of the line, but more frequently a single straight cut is made, as indicated in Fig. 22, with a tenon saw. If the radius is very large other cuts may be made after, as dotted in Fig. 22. This is quicker than cutting it all with a chisel.

A curve which includes end grain is

Fig. 21.—Templates

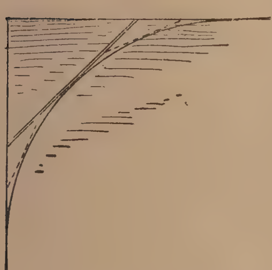


Fig. 22.—Cutting Large Rounded Corner

chiselled in the position shown in Fig. 23; this leaves a number of more or less perceptible flats (Fig. 23). These may be removed with a spokeshave followed by glasspaper on a flat rubber, or glasspaper only may be used. Both spokeshave and glasspaper should be worked only in the

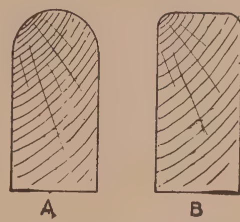


Fig. 20.—Rounded Edges

direction in which the grain cannot be torn up. Concave rubbers are seldom used in glasspapering rounded surfaces, but when surfaces are concave a round rubber is generally essential. The important thing in rounding is to produce a neat and uniform curve with no trace of tool marks. A curve which does not die properly into a straight looks bad but is often seen, not only in the work of amateurs but of those professional carpenters and joiners who are accustomed chiefly to a rough class of work.

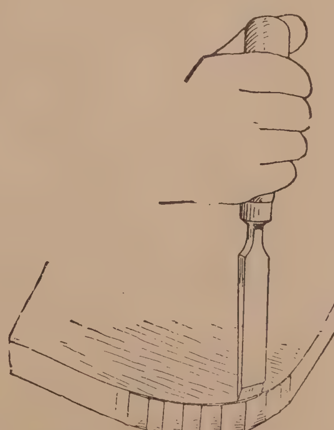


Fig. 23.—Chiselling Corner

Occasionally a comparatively large outside radius is wanted where there is only a limited thickness of material, and this

may necessitate some building up. Thus a corner may be treated, as in Fig. 24, when the interior is concealed. If an inner as well as an outer curve is required the method in Fig. 25 may be adopted, or for a still larger curve it may take the form shown in Fig. 26. Where this is unsuitable a segmental corner piece may be inserted, as in Fig. 27.

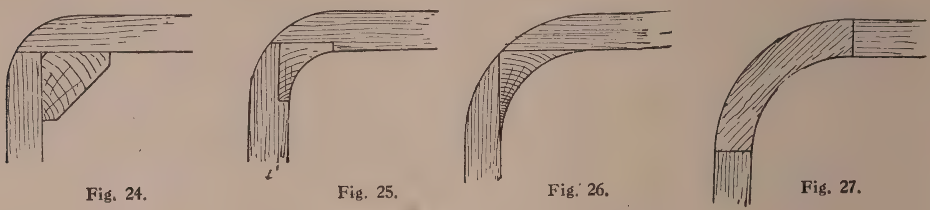


Fig. 24. Fig. 25. Fig. 26. Fig. 27.

Figs. 24 to 27.—Methods of Forming Corners

Rounding Poles and Rollers.—Lengths of wood circular in section may be turned on the lathe or may be worked by hand by using the plane. If made by hand the square piece is first planed octagonal in section. The octagon is usually marked on each end of the timber, and an easy method of constructing the octagon is shown in Fig. 28. First draw the diagonals of the square, and then with compass point on a corner of the section and radius equal to half the diagonal, describe an arch. Repeat for the other four corners. Join the points thus obtained.

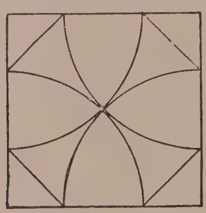


Fig. 28.—Setting Out Octagon

When the timber has been planed octagonal the corners of the octagon are then planed off, giving a sixteen-sided figure in section. The wood will then be approximately circular and can be finished with glasspaper. If the pole or roller is a large one perhaps a little more planing would be necessary, or a "hollow" plane could be used with advantage before glasspapering.

Rebating

The terms "rabbet" and "rabbit" mean the same thing as rebate and are often used. But rebate is probably the original and more correct word. The cutting of rebates is often necessary in woodwork, generally in the formation of joints. It means the cutting of a step or shoulder along the edge of a piece, as in Fig. 1, in most cases transversely to the grain. Usually the end of another piece fits into this at right angles, as in Fig. 2. The advantage of the rebate in such a case is that the outer surfaces of

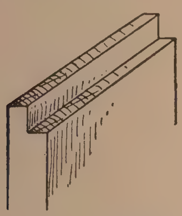


Fig. 1.—Rebate

the parts remain flush, when if simply depending on nails or screws and a plain butt joint they might easily be forced more or less out of position by a blow or severe pressure.

Generally the lines of a rebate are marked before commencing to cut. The wood has usually been planed to the required thickness, width and length, so that the lines can be gauged. Sometimes the rebated end is not finished to length but is left roughly sawn so that the end grain can be trimmed flush after the parts are together. In such a case the distance in of the rebate from the end cannot be marked with a gauge, but lines must be

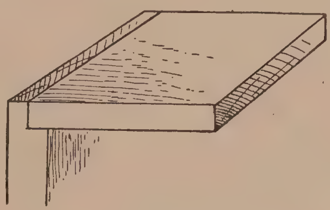


Fig. 2.—Rebated Joint

squared across. When the lines are marked a cut is made with a tenon saw slightly outside of the line, as in Fig. 3, and nearly or quite to the depth of the rebate. This makes it easy to rough-away most of the wood with a chisel and finish with a rebate plane. That

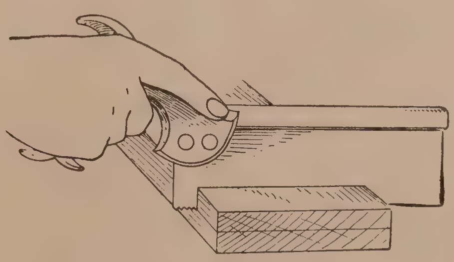


Fig. 3.—Cutting Rebate

is the way of working when no special planes are available, and it is a quite satisfactory method to adopt for just occasional rebating.

A chisel may be used in the vertical position (Fig. 4) or horizontally (Fig. 5). The first is generally more convenient on narrow pieces and the second on wide ones. As a precaution against chiselling or planing below the gauge line it is usual to cut down exactly to it, as in Fig. 6, before the intermediate surface is levelled. Chisel and plane can then be used to reduce to the level required without continual examination to see when the line is reached, for it is easy to see when the bevelled portion at each edge has been removed, and the chief thing to be careful about is to get a straight surface from one to the other. With a plane this is done almost automatically; but a chisel, of course, may go too deep in the intermediate part if not used carefully. Special planes, such as the fillister, trenching or grooving plane, router, and plough, can be set to cut to a required depth and will go no deeper, so that lines are unnecessary. More will be said about the use of these planes a little further on; some of them have already been referred to.

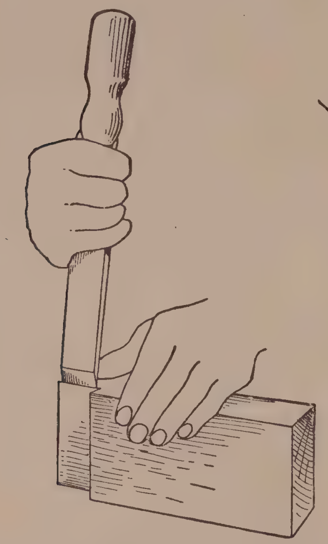


Fig. 4.—Chiselling Rebate Vertically

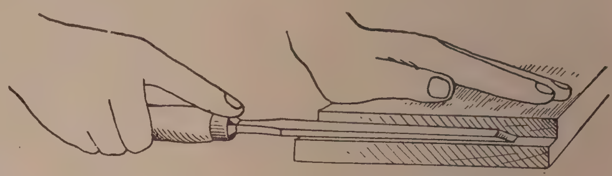


Fig. 5.—Paring Rebate Horizontally

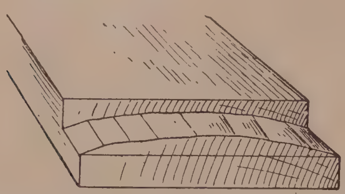


Fig. 6.—Ensuring Correct Depth of Rebate

A rebate plane is used as in Fig. 7. As it is an open-sided plane it cuts close to the shoulder of the rebate. It usually has a skew mouth, that is, the cutter moves forward in a diagonal position instead of at right angles with the sides of the plane body as in most other planes. This enables it to make a cleaner cut across grain and reduces risk of splitting away the farther edge of the work. The usual width of the rebate plane is $1\frac{1}{4}$ in., but narrower ones are made for planing grooves of less width. Strictly speaking, a rebate has a shoulder at one side only and is open at the other, as in all the examples shown. When it does not occur at the end or edge of a piece but at an intermediate place, necessitating a

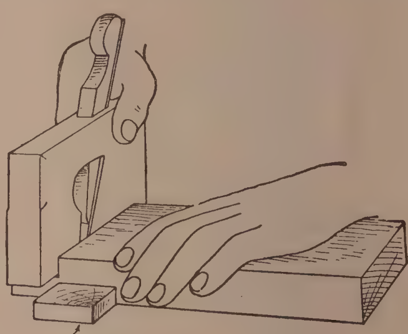


Fig. 7.—Using Rebate Plane

shoulder at each side, it becomes a groove or trench, but a rebate plane can be used for planing it. Rebates and grooves, however, are not always planed. In many cases they can be cut entirely with a chisel. If they are short it may be quicker

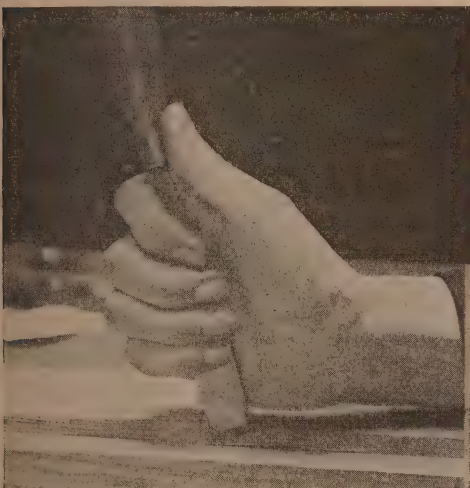


Fig. 8.—Cleaning Inner Angle of Rebate with Chisel

to finish with a chisel than to change from chisel to plane, for a skilled worker can cut as straight with a chisel as with a plane on a short distance. In either case it is advisable to test for straightness with the edge of a try square blade or with the side of the chisel itself.

A chisel is often used for cutting the shoulder of a rebate, or the sides of a groove, exactly to the scribed or gauged line, as a sawcut to the line is rather too rough and inaccurate for some work. Therefore $\frac{1}{16}$ in. or so is left for chiselling and the chisel is used in the vertical position already illustrated. It is set exactly on the line and forced down to the depth of the rebate in a series of cuts, with a slight diagonal or side movement of the chisel simultaneously with the downward movement. In a rebate (though not in a groove) a rebate plane could be used on the end grain, but as a rule a chisel is preferable. End grain is not easy to plane, and the risk of splitting at the far edge is considerable. The shoulder of end grain cannot be chiselled till after the main body of material is cleared out of the rebate. A chisel is necessary also for cutting well down into the angle of the rebate in finishing the latter, for the saw is often stopped slightly short of the full depth, or if it is not the plane cannot always clear shavings completely out of the angle unless the fibres of end grain are severed by drawing the edge of the chisel along. Fig. 8 shows the inner angle of a long rebate being "cleaned," the chisel being drawn first along one side of the rebate and then along the other side.

On very wide pieces a chisel lying on its face, as in Fig. 5, may not be long enough to reach across, perhaps not even half way if worked from opposite sides. In such cases, of course, a plane is essential, and some of the roughing must be done with the chisel face upwards in a tilted position.

When a rebate runs parallel with the grain a sawcut need not be made. Most of the material can be roughed out with a chisel, and a rebate plane can be used

Fig. 9.—Using Temporary Guide whilst Making Rebate

in the ordinary position on the horizontal face and lying on its side to plane the other face. Or a strip of wood can be

nailed temporarily or clamped to the line as a guide for the side of the plane to work against (*see* Fig. 9).

Rebate planes are not restricted to the wooden pattern shown in Fig. 7. There is some variety in the shapes and sizes of metal ones. The ordinary bull-nose and the badger plane (a large rebate plane open at one side only ; *see* Fig. 10) can be used on rebates of greater width than the rebate plane. So also can the jack and other ordinary planes if the surface next to the shoulder of the rebate has first been finished with a plane that cuts right up to it. But rebates are usually limited to about the width of a rebate plane. If much wider they would probably not be called rebates, but would be for the purpose of making halved or

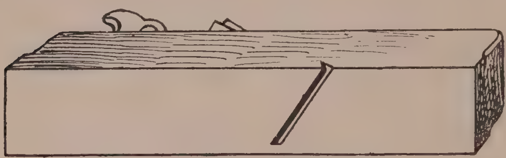


Fig. 10.—Sole of Badger Plane

half-lap joints, while if wide and not constituting joints it would in many cases be better to build them up by putting a piece or pieces on rather than to cut away solid wood.

Use of Fillister Plane.—A plane specially designed for cutting rebates is the fillister (Figs. 35 and 36, page 93) ; it differs from the rebate plane in having a side fence, and in its more elaborate forms it is adjustable for depth of cut and has a slitting cutter in advance of the main cutter, so that even across grain it can be used without making a sawcut or marking lines for planing to. But it is used mainly for cutting rebates with the grain, which are often required in joinery, in window sashes, for instance, and in other framework.

There are three types of fillister—the sash fillister (Fig. 36, page 93) which looks very much like a plough, and is designed for planing a rebate on the opposite side of the wood to that which the fence slides against. There is the moving fillister (Fig. 35, page 93), intended for planing rebates on the same side as the fence ; and there is the standing fillister, which is not adjustable.

A rebate with the grain may be started by ploughing a groove with a plough at the distance and to the depth required.

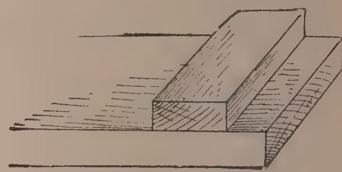


Fig. 11.—Built-up Rebate

and clearing the remainder of the rebate with any planes that are available. If necessary two or more grooves may be ploughed side by side. There are a few other planes intended primarily for cutting grooves, but these are suitable also for finishing rebates. But, as already mentioned, all special planes for work of this character can be dispensed with by a beginner or by anyone who does such work only occasionally. Their value also has been reduced by the fact that where such work is turned out in quantity it is not done by hand but by machine. A great deal of rebating and grooving can be done with a circular saw which is provided with a rising and falling table. It is set so that the top of the saw stands up to the correct distance for

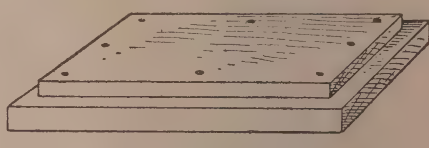


Fig. 12.—Built-up Rebates

cutting to the depth required, and a fence on the table acts as a guide in pushing the wood over the saw.

Built-up Rebates.—A rebate may be built up instead of cut in the solid. Examples are shown in Figs. 11 and 12, the attached pieces being nailed or screwed on. The method in Fig. 11 is common in

some rather rough classes of work, and where it can be adopted it often economises both material and time. The method in Fig. 12 is an alternative to cutting a rebate all round a piece of wood. The smaller piece is planed to width and length and nailed on the other. A rebate at the ends, or at the sides only, could be formed similarly, but as a rule it is better to cut it in the solid. The rebate in a door frame, into which the door fits, is often built up. The lid of a box or chest often fits a rebate which is built up, as shown in Fig. 13.

Fig. 14 is an instance of a rebated joint where the parts are not at right angles. The bead shown is not an essential feature of it, but beads are often used in such

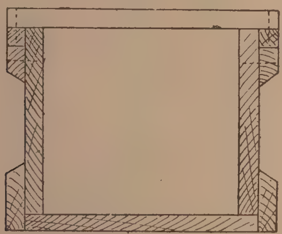


Fig. 13.—Section of Box showing Built-up Rebates

places to avoid the unsightly appearance of a joint in a plain surface. The wood may shrink and the joint open slightly, but the beads make this almost unnoticeable. Instead of a bead the edges of the joint are sometimes chamfered. This type of rebate usually runs with the grain.

Occasionally a shallow rebate may be cut round the edges of a large piece to avoid planing down the entire surface to a thickness required. A rebate may or may not be wanted, but a certain uniform thickness at the edges is important and the piece of wood available may be considerably thicker and perhaps not uniform in thickness. Or it may be warped and a lot of planing would be necessary to make it true on both faces. Some work can be avoided by planing one face true, gauging from this, and going round the edges of the other face with a rebate plane. In large boxed-up foundry patterns this is common.

The inner edges of panelled frames are sometimes rebated instead of grooved. Glass in a wood frame nearly always fits in a rebate. The advantage is that it

Fig. 14.—Rebated Joint

can be inserted after the frame is together and can be replaced if broken. But in a rebate the inserted panel or glass requires something to keep it from falling out. This may take the form of a nailed-in moulding or bead, as dotted in Fig. 15.

Rebates are not invariably straight but may have to follow a curve. The equivalent of a rebate often occurs in turned work and is easily cut, but it is comparatively rare in bench work and is more troublesome, because it must generally be cut rather tediously with gouge and chisel, assisted perhaps with tools of the router class, which are made in considerable variety of form. There is one kind (Fig. 66, page 99), made in spokeshave form, with an adjustable fence to keep the cutter at a fixed distance from the edge of the work. It can be used for curved rebates or grooves. Another is the side router. Routers are used chiefly for finishing work already roughed with a chisel. Compass rebate planes, which have curved soles and sides, are also used.

Stopped Rebates.—Instances sometimes occur when a rebate must have a stopped end instead of running the full

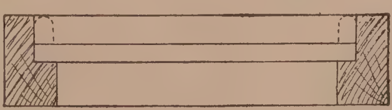


Fig. 15.—Rebated and Beaded Frame

length of the edge it is cut in. Fig. 16 is an example in cabinet work where the appearance of a rebate at the front edge is considered objectionable, and therefore it is stopped and the corner of the fitted-in

piece notched to suit, so that, viewed from the front only, the method of jointing is concealed. Occasionally there are other reasons for stopping a rebate, and sometimes the stop may be formed by building-up methods. In rebated frames, for instance, as in Fig. 15, the rebate must stop at the inner corners. This does not necessarily mean that it cannot be planed through in preparing the pieces. On the two pieces that fit between the rebates would go full length. On the other also it might be stopped, or it might be planed through and made good afterwards. If the corners were mitred it would go through on all four pieces alike. When the corners are tenoned or halved methods of forming the rebate may vary. A safe method for a beginner is to put the frame together and mark and cut the rebate afterwards, mainly with a chisel, but using suitable planes as far as possible; the same method of cutting would be adopted for the stopped rebate in Fig. 16. In the case of a rebated frame the neatest way is to plane all pieces through and modify the joint so that the rebate is stopped, as in Fig. 17.

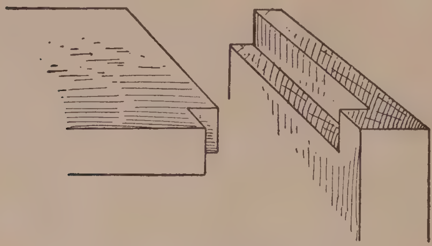


Fig. 16.—Stopped Rebate

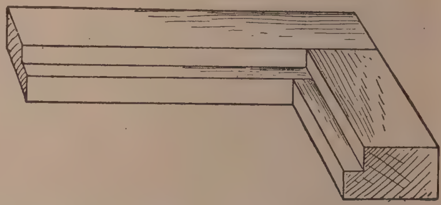


Fig. 17.—Method of Jointing Rebated Frame

Grooving, Ploughing and Tongueing

A GROOVE may be wide and shallow, as in Fig. 1, or narrow and deep, as in Fig. 2. The first is used in framing and boxing up and fitting the ends of shelves into

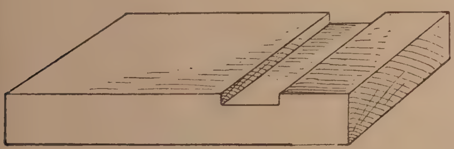


Fig. 1.—Trench or Groove

uprights, and similar work where pieces alike in thickness or nearly so are united at right angles, as in Fig. 3. The second is used mainly in the edges of boards to receive thin tongues or strips of wood,

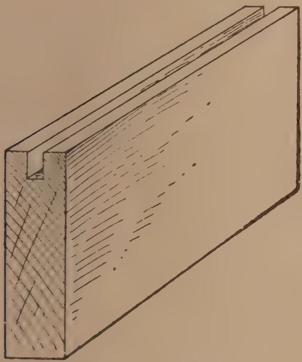


Fig. 2.—Groove

projecting and fitting a similar groove in the next board, as in Fig. 4. Both types of groove are very commonly employed in woodwork. The difference in their proportions makes it necessary to adopt different methods in cutting them. The first can be treated in a number of different ways. Without special tools it can be cut in the way described for rebates. It is first marked out by squaring lines across with penknife or scriber to indicate the width of groove, and its depth is marked with a gauge. Two cuts are then made with a tenon saw, allowing a little for chiselling exactly

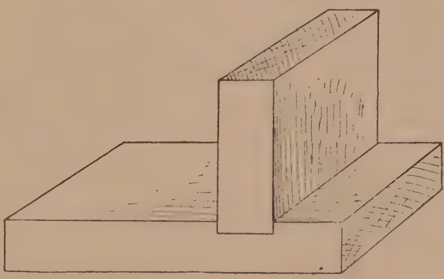


Fig. 3.—Grooved (or Housed) Joint

to the lines, and the wood between the sawcuts is cleared out with a chisel and finished with a rebate plane. In wood about an inch thick grooves of this kind seldom exceed $\frac{1}{4}$ in. in depth. In thinner wood they would often be less, for deep grooves weaken the piece in which they are cut.

The trenching or grooving plane (Fig. 4A) is designed specially for grooves of this class. Like the fillister for rebates, it

is adjustable for depth and has a slitting cutter for the side of the groove. It is a narrow plane, ranging from $\frac{1}{4}$ in. to $\frac{3}{4}$ in. wide, but, of course, can be used in wider grooves. The side rebate is another plane used for planing the edges of grooves in widening them. There is also a great variety of other planes of the rebate and shoulder and router class which can be used in most grooves of moderate size. The sash fillister can be used also in a groove which its fence allows it to reach to, and the same is true of the plough when a groove runs with the grain.

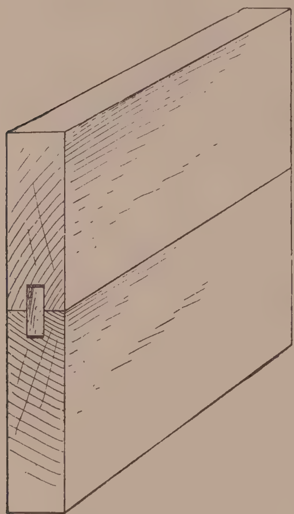


Fig. 4.—Grooved and Tongued Joint

The Plough.—In hand work the plough is the only suitable plane for making grooves for tongues, as shown in Figs. 2 and 4. An exception to this, however, is the matching planes (Figs. 40 and 41, page 94). These are made in pairs, for this work only, and are not adjustable like the plough. One forms a groove of definite size in the edge of a board and the other forms a tongue to fit it on the edge of another board. The tongue then is not a separate strip like the example in Fig. 4. But very little of this kind of ploughing and tongueing is done by hand now, and matching planes are seldom used. A plough has the advantage of adjustability and it possesses a set of cutters of different widths. It can be set to cut to a certain depth, and has an adjustable fence at one side which acts as a gauge in keeping the cutter at a fixed distance from the edge of the wood, so that when the plough is set for the work it will cut the groove without any necessity for marking out or measuring. It will not cut across grain, like the fillister and trenching planes, though it is occasionally used on end grain, but practically all its work is in cutting narrow grooves with the grain.

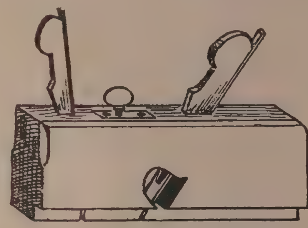


Fig. 4A.—Trenching Plane

Sometimes it is convenient to use it in commencing wide grooves and rebates. Fig. 39, page 94, shows a plough in use. When used on considerable lengths of wood it is best to work it in a series of comparatively short strokes, just as with the ordinary surface planes. But ploughing is commenced at the front end of the wood and gradually worked backwards.

Grooves for the reception of tongues are required on so large a scale that most of this work is done by machinery. Boards for partitions, large panels, floor boards, and boarding for covering large surfaces, could not be grooved and tongued economically by hand, and so the latter is restricted to small amounts in details of joinery and other work, where it is seldom a case of fitting a number of boards edge to edge but of making grooves in pieces which are not of the proportions available in prepared boards.

The plough illustrated in Fig. 37, page 93, is only one of a number of types. But in all alike there is a set of interchangeable cutters, ranging from about $\frac{1}{8}$ in. to $\frac{9}{16}$ in. in stages of $\frac{1}{16}$ in. There is

a vertical metal plate running the length of the plane, less in thickness than the narrowest cutter. The lower edge of this plate is the sole of the plane and bears on the bottom of the ploughed groove,

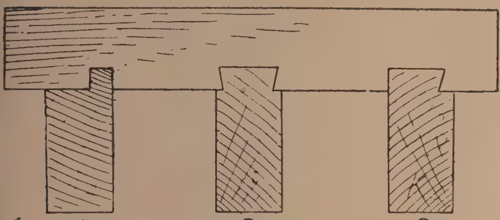


Fig. 5.—Three Types of Grooved Joint

enabling the thickness of shaving to be adjusted suitably. The fence determines the distance of the cutter, and of the groove it cuts from the side of the wood. The fence may have either screw or wedge adjustment, the type shown in Fig. 37, page 93, being adjusted by means of wedges. To set the plane the wedges are loosened, the plane set, and the wedges tightened by tapping them with the hammer. The depth of the groove is determined by a vertically sliding stop at the side of the metal plate. This is raised and lowered by turning the thumb-screw seen on the top of the plane. When the stop bears on the upper surface of the work the plough ceases to cut the groove any deeper.

Returning to grooves of the class shown in Figs. 1 and 3, which usually run across grain, there are some variations in the form they may take. Fig. 5 shows three ways in which such a groove may be modified, each having some advantage of its own. The width of the groove shown at A represents only about one-third the thickness of the piece fitted into it. This is done sometimes in corner or edge joints as an alternative to a rebate; or it may be employed when the fitted-in piece comes so near an edge that a full width groove would leave very short and consequently weak grain beyond. Another, and sometimes the chief advantage, is that the piece fitted in is secure from lateral displacement by having a shoulder to bear against on each side instead of only on one side as in an ordinary rebate. The plough is suitable for cutting such a groove when it runs with the grain. If across grain a plough could not be used because it would tear up the surface too badly. The groove could be sawn and chiselled and finished with other planes, or a special plane called a dado groove could be used, or a narrow trenching plane.

The grooves at B and C in Fig. 5 are dovetailed, so that the inserted piece cannot pull directly out, but must be slid in or out in the longitudinal direction of the groove. There may be a double-sided dovetail, as at B, or a single-sided one, as at C. These are rather troublesome to cut, and are only adopted in high-class work when the additional security they afford is very desirable. The groove would first be cut in the ordinary way to the width of its narrowest part and then undercut with a chisel to the extent of the vee. The parts fitting into them are treated similarly, the dovetail being usually cut with a chisel. Grooves of this kind can be built up by nailing on strips that have had their edges bevelled, or the grooves may be machine-cut.

Figs. 6 and 7 show methods of jointing boards edge to edge when it is considered desirable to have more than the ordinary

Fig. 6.—Rebated and Tongued Joint

Fig. 7.—Double-tongued Joint

provision against an open crack right through the joint, which might occur if the tongue in an ordinary tongued joint became split. In Fig. 6 the joints in the opposite faces of the boards are not opposite each other. In making this joint by hand one edge of each board has a tongue and the other a corresponding groove. The tongue is formed by cutting two rebates which are dissimilar in dis-

tance in from the edge. On the other edge the groove may be ploughed either before or after the single rebate has been cut. Fig. 7 has its outer joints opposite each other but has a tongue and groove side by side on each edge of the board. In this case two rebates and a groove are cut in each edge. As a rule, of course, the edges would be machine-cut, a revolving cutter of the correct profile being employed and a large number of boards done.

Besides the various grooving planes already mentioned there are combination and universal planes. These are provided with a large number of cutters and adjustments which adapt them for a great many different operations, They are entirely of metal, and necessarily rather complicated and expensive compared with the single purpose planes. Some are limited to various grooving operations,

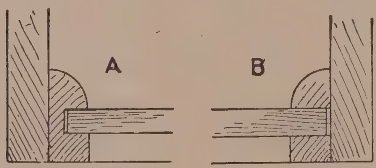


Fig. 8.—Two Methods of Securing Drawer Bottom

such as ploughing, rebating, slitting, matching, with perhaps beading. Others include different kinds of simple moulding, and chamfering. As many as 50 or 60 different cutters may be supplied with a plane of this class, the large number, of course, being accounted for, not being of different shapes, but because the commonly used shapes are in sets of different widths or curves. The best plane of this type is the Stanley Universal plane which will be described later in a special chapter.

Grooves, like rebates, are sometimes built up instead of cut out. Fig. 8 shows two examples where a drawer bottom fits in a groove which is not cut in the sides of the drawer itself but in attached pieces. At A a separate strip is grooved and attached to the side of the drawer. At B two strips are used and the groove is not ploughed at all, but is formed by the space between them. These methods are generally adopted for strength when the sides of the drawer are too thin to be ploughed deeply enough, or when the drawer has to contain heavy articles.

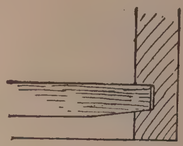


Fig. 9.—Usual Method of Fixing Drawer Bottom

The ordinary method, with no building up, is shown in Fig. 9. Fig. 10 shows a method of fitting panels into frames when a flush surface is required on one side, and a groove central with the thickness of the panel would come too close to the edge of the frame. The edge of the panel is rebated so that the projecting tongue and the ploughed groove it fits into are as far as possible from the edge of the frame.

Varieties and Uses of Tongues.—A tongue is a strip of wood for fitting into a ploughed groove. In cross section it is generally about $\frac{7}{8}$ in. by $\frac{1}{4}$ in. It is usually long enough to go in as a single piece the full length of the joint, but there is no objection, as a rule, to making up the length by inserting two or more shorter strips end to end. As a separate tongue must go halfway into each of the pieces

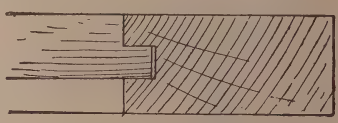


Fig. 10.—Flush Panel

it unites its width must be nearly double the depth of the ploughed groove in the edge of each piece; it should not be quite double or there might be some risk of its preventing a close joint between the pieces. When it is formed solid on the edge of one piece and fits into a groove in the other it should still not quite reach to the bottom of the groove. This is indicated in preceding illustrations

where tongues fitting in grooves are shown.

A tongue is not used because it is of any value in holding parts together. Its purpose is partly to keep the outer surfaces flush by preventing side movement in relation to each other, and partly to avoid an open crack right through the joint if the latter is not quite close. Wood is liable to shrink or to swell as it loses or acquires moisture, and therefore absolutely tight joints are not always possible or desirable. A tongue in the joint allows shrinkage, but it is a barrier to a direct passage through.

In work where grooving and tongueing is done on a large scale tongues are sawn to size on a circular saw. Width and thickness must be exact, but length is anything that happens to be convenient. If sawn by hand some amount of planing is necessary afterwards to get the thickness exact and uniform, but the edges can generally be left as sawn. Usually the thickness of the board they are cut from would represent the width of the tongues, and this would be quite near enough without gauging and planing to width. Exceptions might occur in very fine and exact work or when the tongues are wider than they are wanted. In thickness a tongue should be a reasonably close fit in its groove but not so tight as to require driving in.

The grain of a tongue usually runs lengthwise, but exceptions to this are sometimes made. It may run either crosswise or diagonally, in which case, of course, the loose tongue is very weak transversely and can easily be snapped off anywhere. But when inserted this weakness does not matter; in fact, unless the joint is very short the tongue has to be inserted in short lengths, because long ones across grain are unobtainable. The advantage of having the grain across instead of lengthwise is that it cannot split down the middle as a tongue with longitudinal grain might. Tongues with cross grain may be cut from a board the same thickness as the tongue, or a thicker board may be used and the strips sawn down into two or more afterwards. The advantage of diagonal grain is that longer strips can be cut diagonally than at right angles across a board, and there is also slightly less risk of breakage, because there is a greater length of grain to split when it is diagonal than when it is direct across the strip.

The tongued joint may be glued or may be simply put together without glue, the latter being commonest. A joint is glued when a single piece would be preferred if it could be obtained wide enough. The reason for gluing is to make a practically solid piece. But the risk of shrinkage makes it impossible to glue

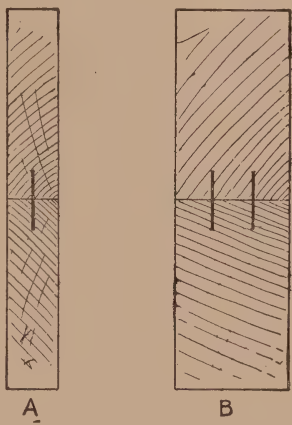


Fig. 11.—Metal Tongues

up very great widths and at the same time prevent them from warping and splitting. Therefore a number of narrow pieces, each free to shrink independently of the others, is the best way in many cases, and the joints are not glued.

When glue is used in edge joints there is no great advantage in using a tongue as well, and in the majority of such cases it is omitted. To make a good glue joint it is necessary to have the wood surfaces in tight contact everywhere with only a thin film of glue between. This is done by pressing and sliding the parts over each other to squeeze all superfluous glue out, and then usually by clamping until the glue is dry. When a tongue has to be inserted one of the grooved pieces is held in the vice, as in making an ordinary

edge glue joint, and the tongue is glued in and secured with a few nails to keep it from moving endwise while the other piece is being adjusted on it. Plenty of glue is applied to the edges of both pieces, and they are fitted together and the upper one slid a few inches each way with as much downward pressure as possible and finally adjusted with its ends flush with the ends of the lower piece. Then clamps are applied to keep the joint squeezed together and it is laid aside for a few hours to dry.

Metal tongues are sometimes used instead of wood. They do not require a ploughed groove, but can be inserted in a sawcut, which is usually made with a circular saw. They are not only strong themselves, but the narrow groove they require diminishes risk of breaking the ledges of wood on each side of the groove. A central tongue may be used, as at A in Fig. 11, or if the joint is wide two tongues may be inserted, as at B. In very wide joints two wooden tongues are sometimes used similarly.

Shooting and Mitre Cutting

Shooting Square Work.—When it is required to joint-up thin boards to form panels, etc., this may be done by overhand planing, or shooting as it is sometimes termed. Each board is fixed in turn in the vice and the edges planed straight and square as shown in Fig. 1 (*see* also Figs. 13 and 14, p. 103). When one piece is placed on the other the surfaces forming the joint should touch each other the whole length, and the broad surfaces should be in one plane, so that when a straightedge is applied it will touch both of them, as illustrated by Fig. 2.

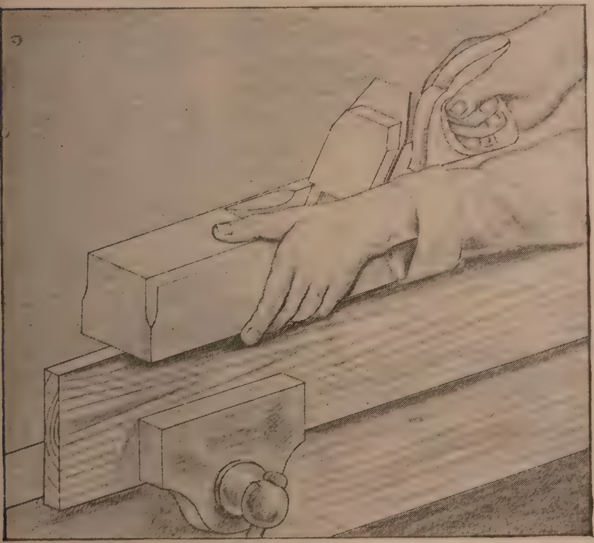


Fig. 1.—Overhand Planing or Shooting

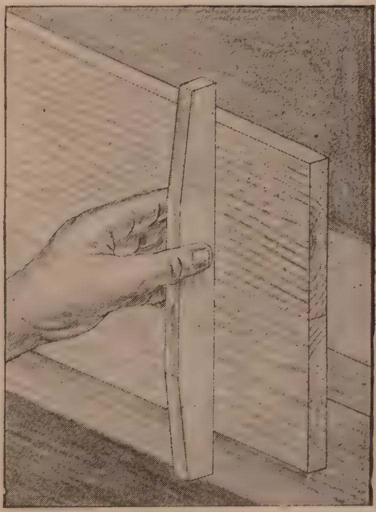


Fig. 2.—Testing Jointed Boards with Straightedge

Construction of Shooting Boards.—The method described above is difficult and requires a deal of skill, and is not convenient where much jointing and thin-edge planing is required; therefore the shooting is generally done with the help of a shooting board, which in size may vary according to the purposes for which it is required. A useful size is made by having a 9-in. or 11-in. by $\frac{7}{8}$-in. board for

the base. A piece 5 in. to 7 in. wide and $\frac{3}{4}$ in. thick is fixed on the top of this. The length may be from 2 ft. 6 in. to 4 ft. A stop made of hardwood is housed into the top board, as shown in Fig. 3. Shooting boards are liable to warp, as shown exaggerated at Figs. 4 and 5, which causes the plane to shoot the edges of the work out of square ; this can be obviated by screwing ledges to the underside (hardwood being the best for the purpose) and so keeping the board true, as shown at Figs. 6 and 7.

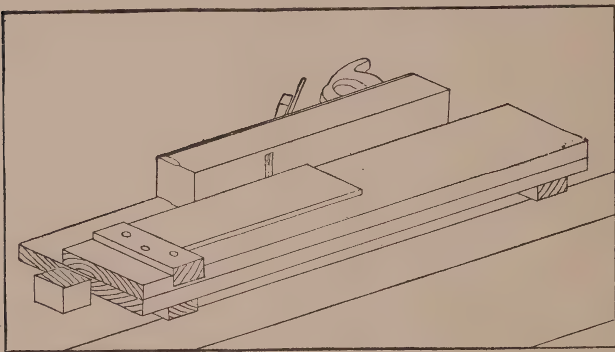


Fig. 3.—Using Shooting Board

Fig. 4.

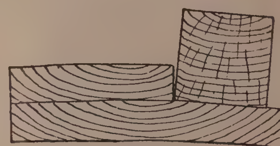


Fig. 5.

Figs. 4 and 5.—Faulty Construction of Shooting Boards

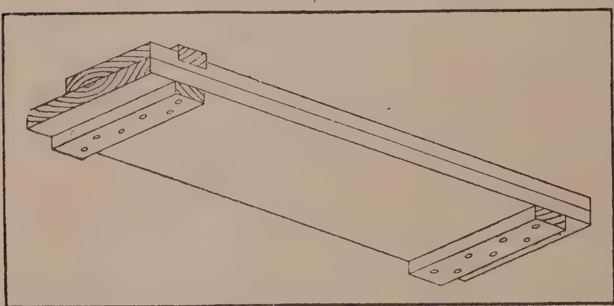


Fig. 6.

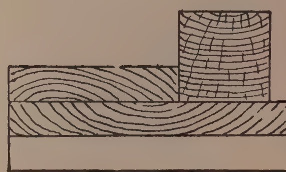


Fig. 7.

Figs. 6 and 7.—Shooting Board prevented from Warping by Ledges

Using the Shooting Board.—It sometimes happens that the edges of the work are not shot quite square owing to the shooting board wearing or warping or to the face of the plane not being at right angles to the side that is on the rebate of the shooting board (Fig. 8). Then if the face side of each piece is placed on the shooting board and planed, when they are tried together their face sides are not in one plane, as shown in Fig. 9 ; whereas, if the face of one piece is placed downwards on the shooting board and the other piece upwards, they come together, as shown in Fig. 10.

Shooting Edges at an Angle.—When it is required to plane edges at an angle other than a right angle, if the material is $\frac{3}{4}$ in. or more in thickness the work is frequently done by overhand planing. A bevel is then set to the required angle and applied to the ends of the stuff, as shown at Fig. 11, and marked. The work is then planed to the lines and also to fit the bevel (Fig. 12) which is frequently applied during the process of planing.

Shooting Block.—For thinner material a shooting block is more convenient. Where there are only one or two pieces to be done, just one or two blocks of

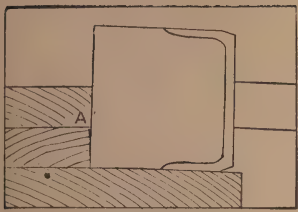


Fig. 8.—Shooting Out of Square

Fig. 13.—Built-up Shooting Block for Bevelling Edges and Ends of Work

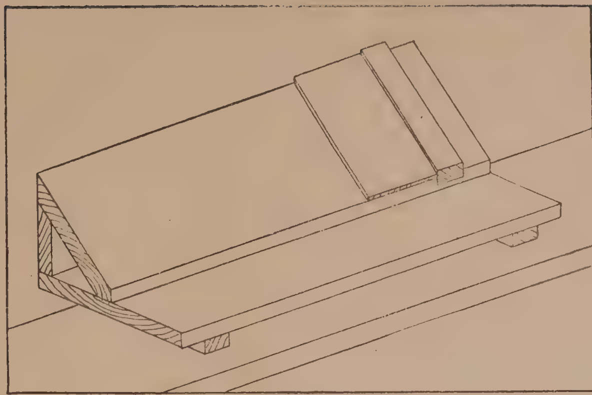


Fig. 13.

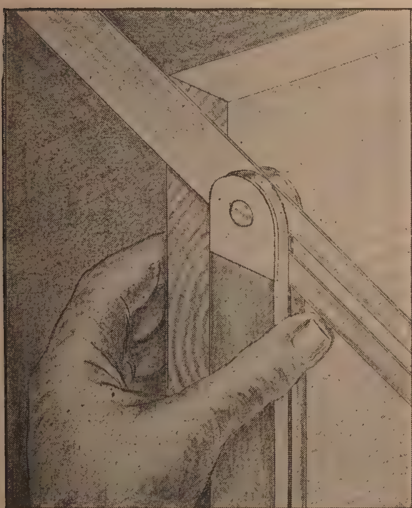


Fig. 11.—Applying Bevel to End of Board for Marking

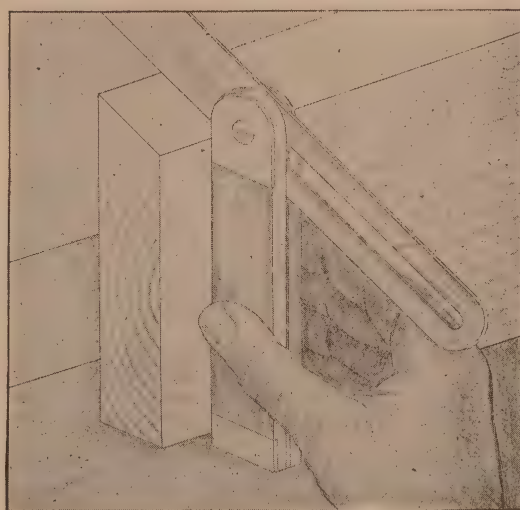


Fig. 12.—Testing Planed Edge with Bevel

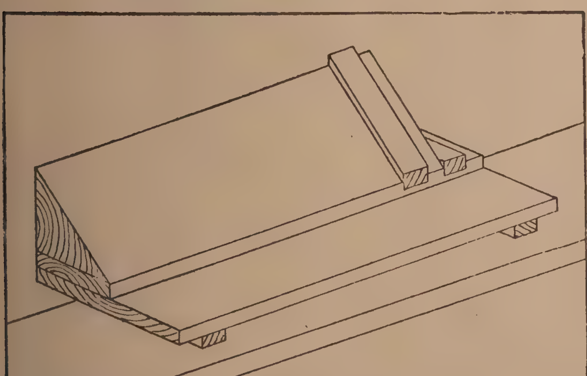


Fig. 14.—Movable Block Dowelled to Ordinary Shooting Board

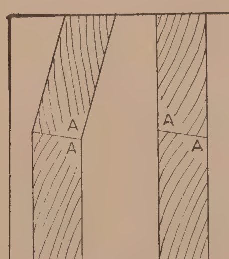


Fig. 9. Fig. 10.

Fig. 9.—Placing Boards Together so that Adjacent Angles are Equal

Fig. 10.—Placing Boards Together so that Opposite Angles are Equal

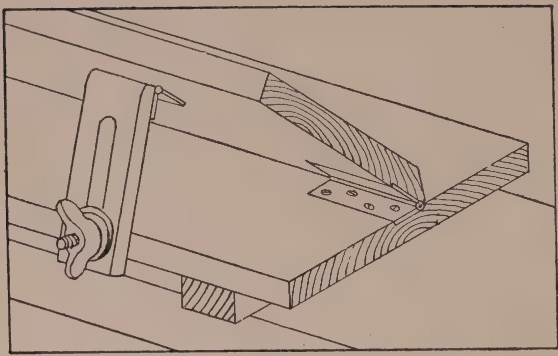


Fig. 16.—Adjustable Shooting Block

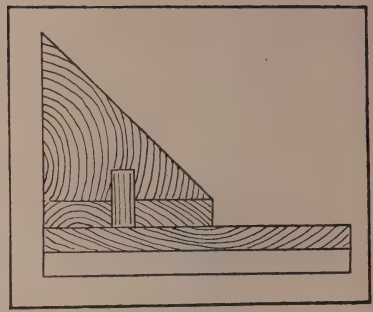


Fig. 15.—Section through Movable Block showing Dowel

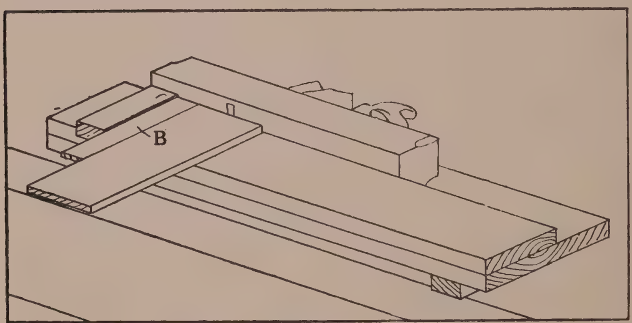


Fig. 17.—Shooting End-grain

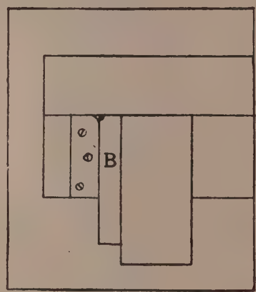


Fig. 18.—Using Piece to Prevent Breaking of Corner

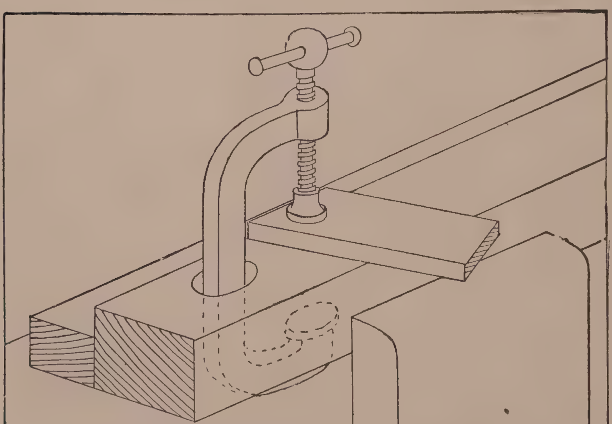


Fig. 20.—Shooting Block with Adjustable Stop

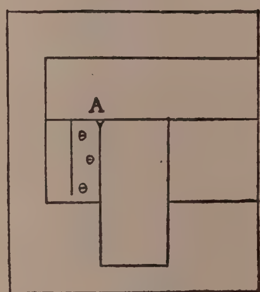


Fig. 19.—Faulty Method, Corner Broken

wood cut to the particular angle and temporarily screwed to the shooting

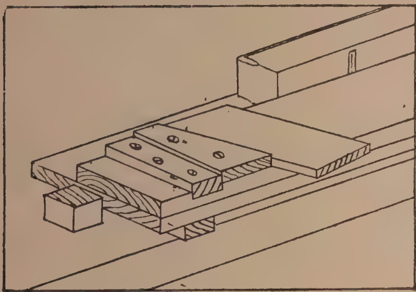


Fig. 20A.—Shooting Ends at an Angle

block will probably be found sufficient. But when there are a number of pieces to be done accurately, then it will generally pay to have a more or less permanent block. Fig. 13 shows a block built up. Figs. 14 and 15 illustrate a solid triangular piece trued up to the desired angle; by means of three or four dowels it can be made readily to fit on or be taken off an ordinary shooting board. Fig. 16 shows one end of a very useful and simple form of adjustable shooting block which can be set to any angle within its limits.

Shooting End Grain.—Fig. 17 shows

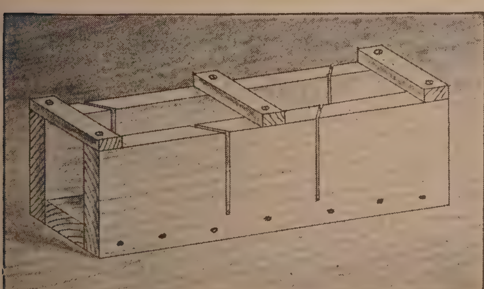


Fig. 23.—Ordinary Mitre Box

the operation of shooting end grain square to an edge. After a time the end of the stop becomes worn and does not properly support the corner of the work, and

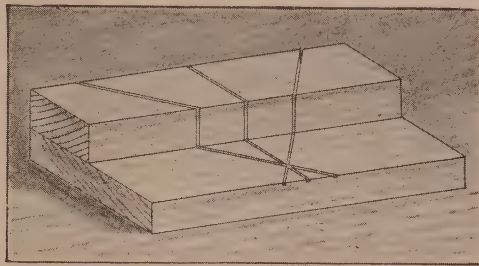


Fig. 21.—Ordinary Mitre Block

the fibres forming it become broken, as at A, Fig. 19, by the plane-iron edge.

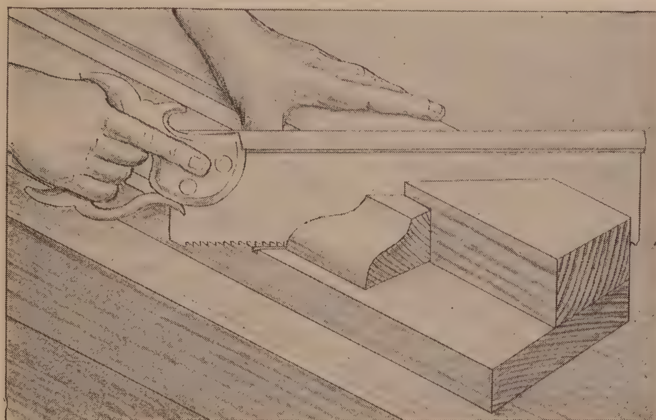


Fig. 22.—Cutting Mitre

Therefore it is a good plan to have an

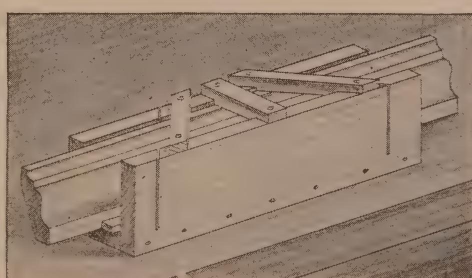


Fig. 24.—Moulding in Position in Box

intervening piece, as shown at B, Figs. 17 and 18, then the end of the work and

this piece are shot together, which prevents the corner of the work being damaged. This matter has already been alluded to in the chapter on general planing.

Shooting Ends at an Angle.—When it is required to shoot ends at an angle a wedge-shaped piece can be cut to the proper form and fastened to the ordinary shooting board, as shown at Fig. 20A.

A very convenient kind of shooting block with adjustable stop is represented by Fig. 20. The block is bored and pared so as to receive a strong form of G-cramp, which will hold the stop firmly at any desired angle, and which can be quickly altered as found necessary.

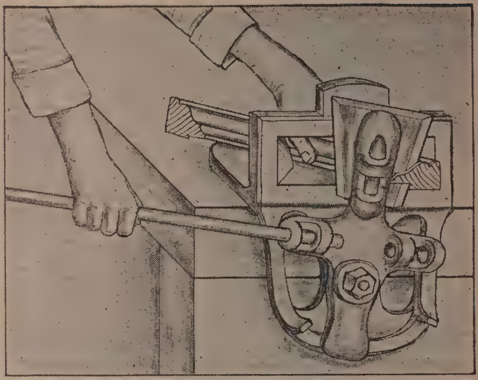


Fig. 26.—Mitre Trimming Machine

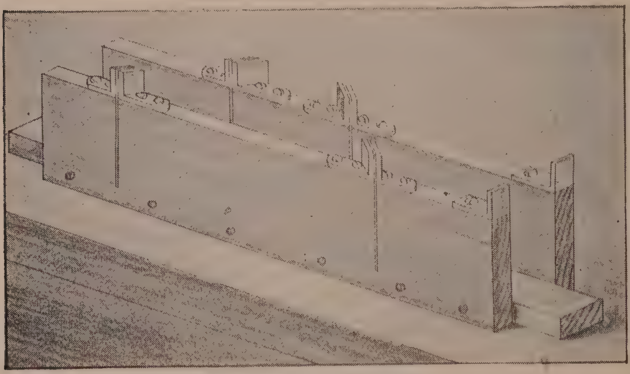


Fig. 25.—Adjustable Guides to Box

CUTTING MITRES

Mitre Cut or Mitre Block.—In Fig. 21 is shown the ordinary mitre cut made of two pieces of wood; these are fastened together by a little glue and also are nailed from the underside of the base. This is a very useful form of mitre cut for general purposes, particularly for small mouldings, and the work and block can be held together by the left hand, as shown in Fig. 22.

Mitre Box.—The ordinary mitre box is shown in Fig. 23. This is used for deeper and larger mouldings than can be cut by the mitre block. Fig. 24 shows a cornice moulding in position. This kind of mitre box can be used for different sizes of mouldings by inserting a fillet of the proper width, as shown.

Fig. 25 illustrates a mitre box with metal guides, which are screwed upon the edges as illustrated; they can be adjusted to suit any thickness of saw; as they greatly reduce the wear of the cuts in the box, truer mitres can be cut for a much longer period. The metal guides can also be obtained for cutting square ends, and may be

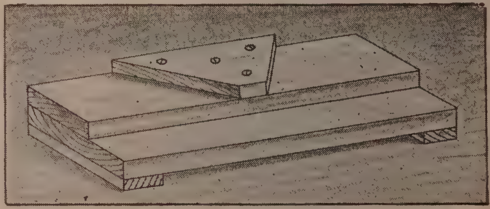


Fig. 27.—Ordinary Mitre Shoot with Solid Fence

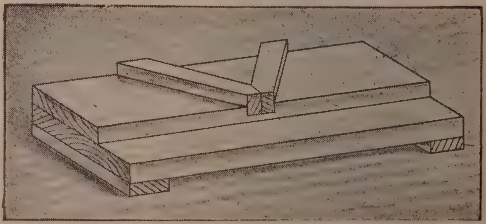


Fig. 28.—Mitre Block with Two Stops

used at the end of the box as shown or in pairs at the top of the cuts.

Metal Mitre Cut.—There is a number of excellent, and, of course, expensive, mitreing machines on the market, but probably one of the handiest is illustrated by Fig. 26. It will cut mouldings of a good size and mitres at any angle within the compass of the machine. It cuts mitres true and smooth, obviating any necessity of shooting. A much later chapter will deal in detail with the use of this and similar simple machinery.

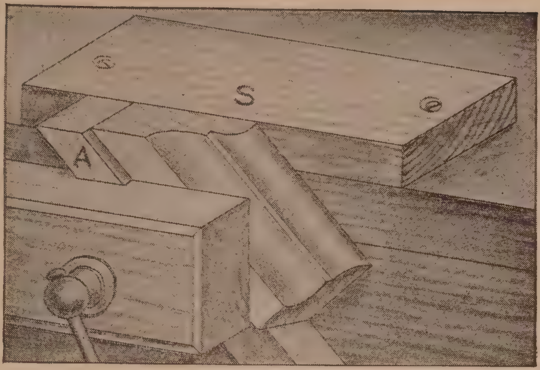


Fig. 30.—Improvised Shooting Block

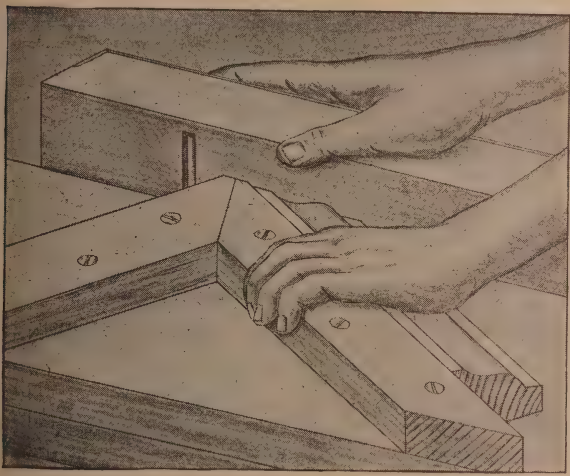


Fig. 29.—Shooting Mitre

Shooting Blocks.—A very useful improvised block is shown at Fig. 30. A piece of wood is screwed to the top of the bench and its surfaces well planed so that it is quite square with the side of the bench; then a fillet is screwed to the side of the bench almost touching the screw and at the mitre angle with the piece S. The upper end A may be thicknessed out as shown. Then by holding the plane on the skew so that the iron cuts the mitre whilst the other part of the sole of the plane is kept firmly on the piece S, as will be seen, the bench vice can be brought into use to hold the moulding firmly.

SHOOTING MITRES

Mitre Shoots.—The two common kinds of mitre shoots are shown in Figs. 27 and 28. The base is shown battened, or ledged, underneath so as to prevent warping, which would cause untrue mitres. The handiest kind is that shown by Figs. 28 and 29, because the work and the mitre stop can be grasped firmly together, as shown at Fig. 29.

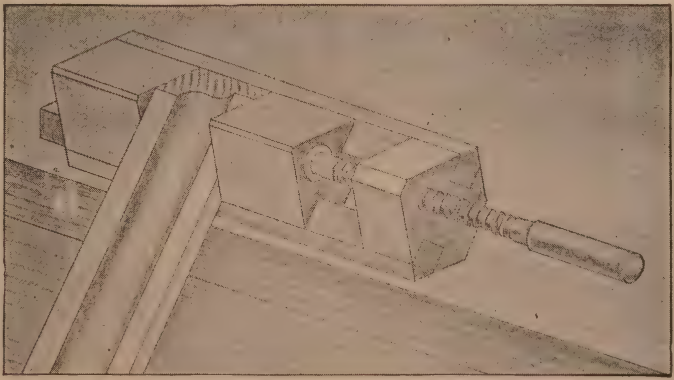


Fig. 31.—Good Form of Mitre Shooting Block

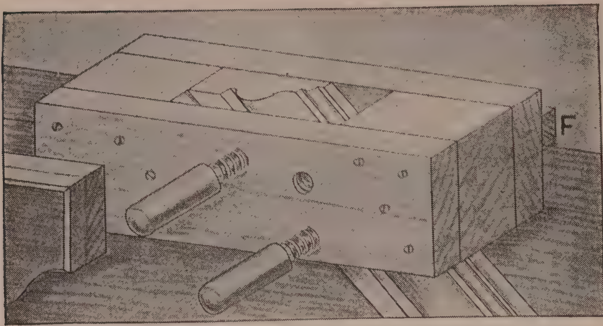


Fig. 32.—Another Kind of Mitre Shooting Block

Fig. 31 illustrates a most useful kind of shooting block which will hold mouldings of different sizes. If desired, this kind can be bought ready-made with either a wooden or steel hand-screw.

The shooting block shown by Fig. 32 has its advantages, being simple to make and also suitable for being held firmly in the bench vice. To prevent slipping, a fillet F can be fixed at the back of the block so as to rest on the top of the bench as shown.

Of course, in using this kind of block great care must be taken to have the plane irons set very fine and to hold and use the plane so that the mitre of the moulding is cut by the iron and not the surface of the block.

During recent years many accurate mitreing appliances constructed of steel have been introduced. For example, Fig. 33 shows an appliance especially made for use with a steel plane, and it will be noted that the angle of mitre is adjustable. Still other appliances will be mentioned in connection with special applications of mitreing discussed in later chapters.

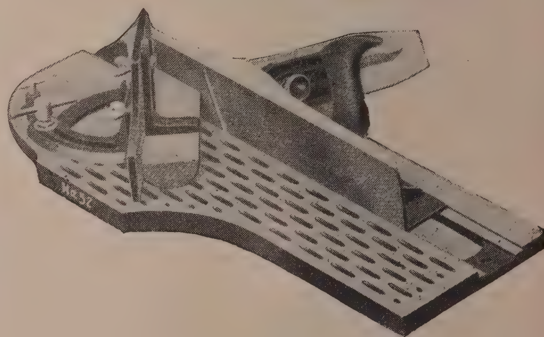


Fig. 33.—Metal Shooting "Board"

Timber: Conversion and Seasoning

Introductory.—A tree should be felled in its prime. If it is prematurely cut down the larger quantity of sap-wood causes too much wastage, and if it is allowed to grow too old it is inferior in toughness and strength. The oak tree is mature for felling between eighty and a hundred years' growth; ash, elm, and larch between sixty and a hundred years; the poplar between forty and fifty years. Spruce and pine trees are felled between seventy and a hundred years of age.

As the sap is drawn up the tree for nourishment during the spring and descends in the autumn the tree is at its driest period during the winter, which is the time, in temperate climates, chosen for felling trees. There is, however, always a large amount of sap remaining in the tree, which is of such a quantity that its weight is half as much as the timber itself; that is, when dry timber loses about one-third of its weight. This condition for practical purposes is not generally attained, and is only approached and approximated for the best cabinetwork and joinery.

SEASONING TIMBER

When drying or seasoning timber shrinkage takes place circumferentially, the shrinkage in diameter being comparatively small. The annual rings shorten, and if the timber is left whole in the log too long many vee-shaped shakes will appear and spoil the timber. To prevent this happening, the log is sawn into planks to the desired thickness and stacked for drying, and the timber then seasoned either by natural or artificial methods.

Natural Seasoning.—Though the use of drying kilns is increasing the bulk of our wood is still seasoned in the open air. If kept in the air long enough, the moisture content of the wood finally comes into equilibrium with that of the surrounding atmosphere, and the wood is said to be air-dried. The rate of drying varies, of course, with the time of year, species of wood, size and form of piece, and method of piling. Certain of these factors may be controlled or utilised in a way to hasten the drying process and lessen the likelihood of defects appearing.

Sawn timber generally is dried by being piled in stacks with air space between the boards. In forming the stacks the boards usually are laid flat, with strips called "stickers" (or "skids") between courses or layers. A space also is left between each board in a layer and the adjacent board to provide for circulation of air throughout the stack. Flat or horizontal piling may be of two kinds: (*a*) With the ends of the boards toward the alley—endwise piling, and (*b*) with the sides toward the alley—sidewise piling. Figs. 1 and 2 illustrate the two methods. The stacks are arranged to slope from front to rear, and to lean forward so that water dripping from the top falls to the ground without trickling down over the courses below. With either method of piling

the stacks should be so located in the yard that the prevailing winds blow through them rather than against the ends.

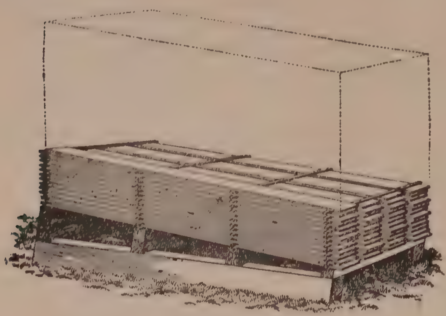


Fig. 1.—Endwise Piling of Timber

Most timber manufacturers and dealers use the endwise method of piling. A number, however, have adopted the sidewise method, which has certain advantages in the matter of air circulation. In endwise piling the stickers obstruct the passage of air from back to front of a course, while in sidewise piling the passages from front to rear are clear. Water which forces its way into the pile is more efficiently drained in sidewise piling, and the likelihood of sticker rot and discoloration due to the accumulation of moisture, dust, and dirt against the stickers is lessened.

The bottom boards in a stack rest on skids, which in turn rest on foundations, preferably of stone, cement, or metal. Pieces containing rot should never be used for foundation timbers or skids, or allowed to remain in the pile. The vicinity of the pile should be kept clear of weeds.

The use of cement and metal foundations is especially feasible in retail timber yards and in those maintained by wood-using factories. In retail yards, where economy in space often is the essential thing, the piles are high and a particular space usually is allotted to each class or species of timber. In factory yards timber often is held for a number of years before being used. In such cases the frequent renewal of wooden foundations under timber piles entails considerable expenditure of time and money, to say nothing of the danger of infecting the wood by bringing it in contact with partly rotted foundation timbers. For these reasons foundations of a more permanent character are constantly growing in favour in retail and factory yards.

Kiln-drying.—Timber is kiln-dried when there is need for seasoning it quickly, or when the manufacturer does not wish to carry large stocks in his yard. A kiln is used also to further dry partially air-seasoned or even fully air-seasoned material, for special uses.

The main problem in kiln-drying is to prevent the moisture from evaporating from the surface of the pieces faster than it is brought to the surface from the interior. When this happens the surface becomes considerably drier than the interior and begins to shrink. If the difference in moisture content is sufficient the surface portion opens up in checks.

The evaporation from the surface of wood in a kiln can be controlled to a large degree by regulating the humidity, temperature, and amount of air passing over the wood; and a correctly designed kiln, especially one for drying the more difficult woods, should be constructed and equipped in a way to ensure this regulation.

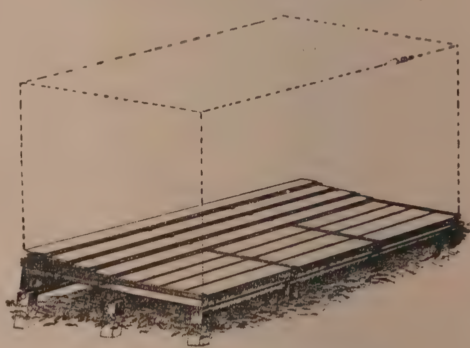


Fig. 2.—Lengthwise Piling of Timber

A dry kiln may consist simply of a box in which timber can be heated, or of a good-sized building or group of buildings (battery) containing steam pipes, condensers, sprays, and various air passages

capable of adjustment to regulate the amount of ventilation.

Kilns for drying timber may be divided into two classes: (*a*) compartment kilns (Fig. 3) and (*b*) progressive kilns (Fig. 3A). In compartment kilns the conditions are changed during the drying process, and all timber in the kiln is dried at one time. The conditions at any time during drying are uniform throughout the whole kiln. In a progressive kiln conditions at one end differ from those at the other, and the timber is dried progressively by being passed through the kiln. Compartment kilns are used when it is desired to dry timber of various sizes and species, while progressive kilns are used where uniform stock is handled.

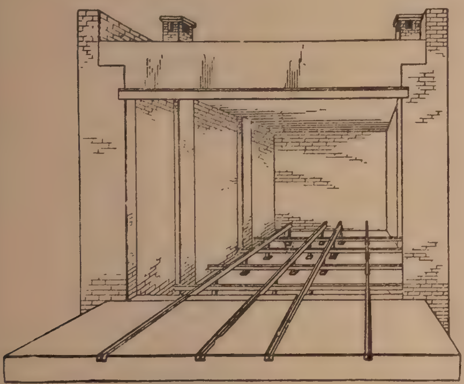


Fig. 3.—A Compartment Kiln for Timber Drying

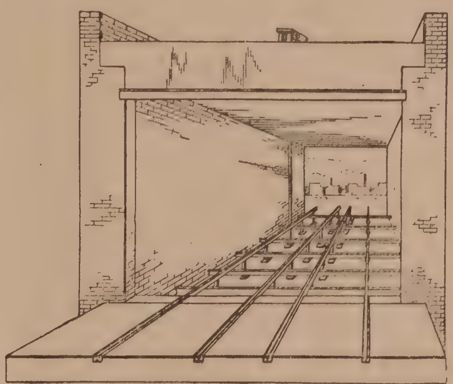


Fig. 3A.—Progressive Kiln for Timber Drying

Seasoning Timber Strips.—An apparatus for seasoning small strips is shown in Figs. 4 to 7. The smaller the cross-section of the strips to be seasoned, the less time is required to complete the process. Possibly if the strips are very small, say 1½ in. by 1½ in. or 1 in. by 1 in., a day in such an apparatus as that illustrated herewith would render them fit for all ordinary purposes.

A rectangular structure, the walls of which could be made of coke breeze concrete, is lined inside with sheet asbestos or coated with fireclay. The concrete walls are reinforced with light wrought-iron bars to increase the strength and rigidity of the structure. The dotted shading in Figs. 4, 5, and 6 represents the walls of the structure. The two central vertical walls are so arranged as to leave a space (C, Fig. 4) between them, and a horizontal wall shuts off the lower portion C of this space from the top portion.

At the back end of the structure a boiler B (Figs. 5 and 6) is fixed at a slightly lower level by making a pit. This boiler could be obtained from any of the makers of horticultural heating apparatus. Flow and return pipes are connected with this boiler, as shown in Fig. 5. The air in the chamber C is thus brought to a very high temperature. The heated air from C is allowed to pass alternately into each of the two drying chambers E (Figs. 5 and 6) by means of slides S, operated from handles H at the front of the structure. Thus, when the timber is stacked in one of the drying chambers E ready for seasoning, the slide S (Fig. 6) is withdrawn, as shown, and the hot air allowed to pass from the chamber C through the opening O into one of the drying chambers E. Meanwhile, the other slide S_1 is closed as shown, and so shuts off the hot air from the drying chamber from which the dry timber is to be removed. The moist air from the drying chambers E and E passes through an aperture F into a hollow chamber D at the rear end of the structure, into which the fumes from the boiler B

are also carried. This ensures a good draught up the flue J.

Fig. 4, which is partly a vertical section and partly an elevation, represents the front end of the apparatus. The doors shutting off the drying chambers are arranged in such a way as to keep the hot air from escaping. The doors may be made to lift up to open, as shown; or they may be hinged in the same way as an ordinary oven door. If made to work vertically, some method of counterweights must be arranged to take off the weight of the door in lifting.

In order to avoid the necessity of stacking the timber each time in and around the drying chambers, trolleys are provided. These are constructed with flanged wheels and run on rails. The sides of the trolleys should not be solid, but should be of iron, bolted together in such a way as to leave ample space for the hot air to circulate around the timber. Near each end of the trolley are fixed U-shaped iron uprights, as shown in Fig. 7.

After having placed the bottom layer of strips horizontally on the bed of the trolley a bearer is dropped down at

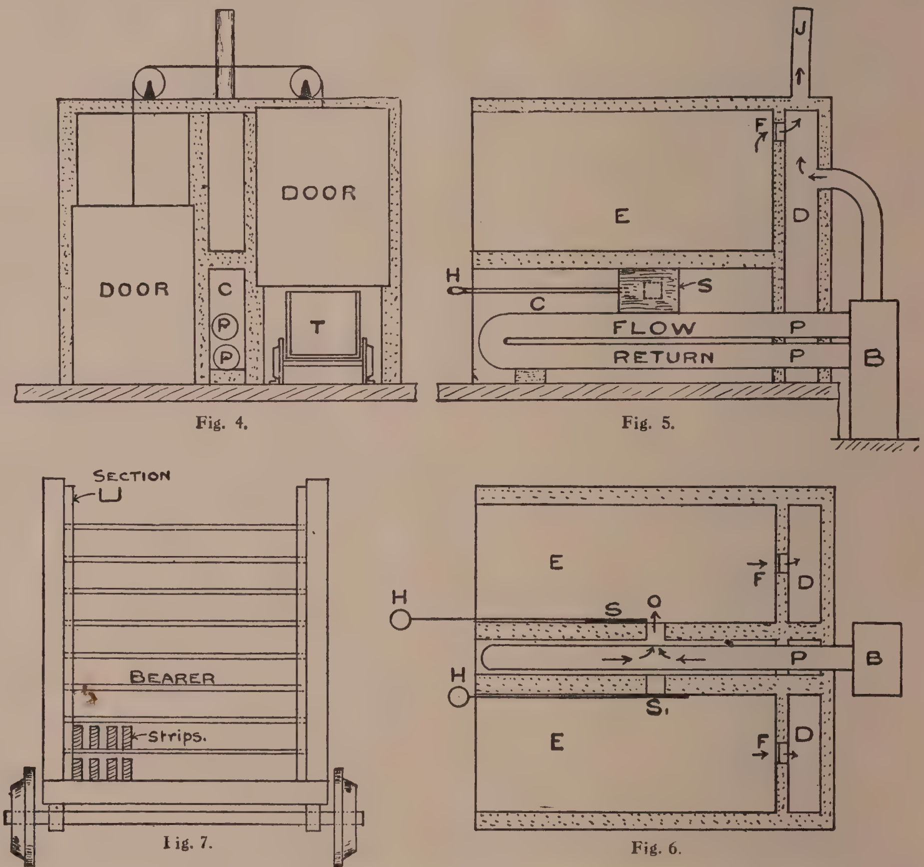


Fig. 4. Fig. 5. Fig. 7. Fig. 6.

Figs. 4 to 7.—Apparatus for Seasoning Timber Strips—Sectional Elevation, Side Sectional Elevation, Sectional Plan, and View of Trolley

each end between the two U-shaped uprights until it rests upon the first layer of strips. The next layer of strips is

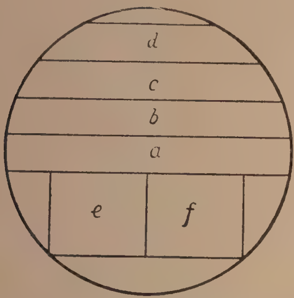


Fig. 8.—Log Cut into Planks and Beams

then laid transversely on these bearers and another pair of bearers dropped into position, and so on until the trolley is loaded. While this trolley is being loaded up in this way the other loaded trolley is within the closed drying chamber into which the hot air from C has been admitted through O (Fig. 6), by withdrawing the slide S. A considerable amount of time is saved in this way, and the operator is kept busy for the greater part of the time.

If an anthracite stove, such as the "Esse," is used it would only require attention once a day, and would feed

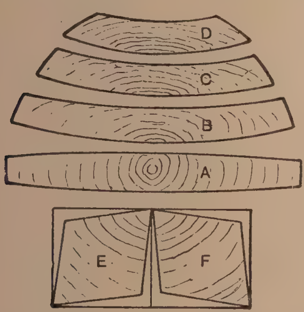


Fig. 9.—Effect of Shrinkage on Sawn-up Log

itself automatically, keeping the heat at a steady height continuously day and night. Thus a trolley loaded up during the day could be run into the chamber at night and safely left until early morning, when it could be withdrawn and another —loaded by someone working a night shift—could then be run into the other chamber.

By making the structure sufficiently long from the front to the boiler end it could be made to accommodate two trolleys in each of the drying chambers, or four altogether. The number of strips handled would thus be increased greatly without any undue amount of extra labour or of initial expenditure.

Fig. 10.—Beams Cut Square with Tres

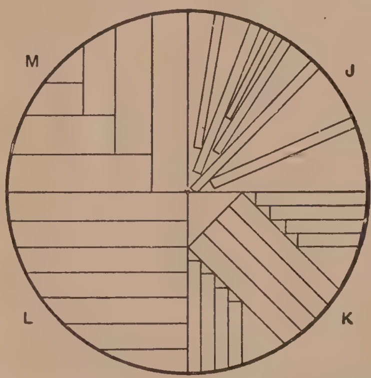


Fig. 11.—Converting Oak Log to "Silver-grain" Panelling, Quarter-stuff, etc.

CONVERSION

Conversion of timber is the operation of sawing the log into planks, deals, battens, etc., and this is generally done before seasoning. The subsequent shrinkage is noticeable in the portions when cut as illustrated. Take, for instance, a log cut into planks and beams shown in Fig. 8. The middle piece *a*, when dry, will remain practically the same width and of the same thickness in the middle. The thickness of the edges will diminish a trifle as shown exaggerated in A (Fig. 9). The piece *b* will take the shape of B. Owing to the shortening of the rings, this piece will shrink in its width more on the upper sur-

face than the surface next to the heart of the tree, giving the plank a curved shape as shown. This also will be a trifle thinner at the edges than in the middle; *c* and *d*, following the same action, are shown; the shrinkage in width is more marked, but they keep more parallel in thickness. The tendency to distort with rectangular-shaped pieces is shown in E and F; if the rectilinear shape is to be preserved they must be cut square with the tree, as in G and H (Fig. 10).

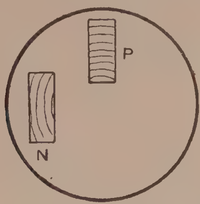


Fig. 12.—Getting Beam or Joist from Log

If boards are required that will not shrink in width, nor warp untrue, they must be cut, as shown in Fig. 11 at J. This method is also pursued in cutting oak panelling to obtain the full figured silver grain. It is an expensive method of converting timber, because it entails more waste, but most of the vee pieces can be utilised for feather-edged tiling laths and for oak fencing, etc. A more economical method to approximate the above advantages is shown at K. For ordinary boarding, sometimes known as "quarter-stuff," it is cut as at L; M is the best method of cutting "thick stuff." When cutting the log for beams or joists, or where strength is a more important matter than shrinkage, it has been proved the best to cut tangentially to the annual rings as at N in Fig. 12; this is stronger than when cut as at P.

Deals are cut from the Scandinavian fir trees according to the size of the log, as shown in Figs. 13 and 14. A method of cutting pitch pine and other timbers, for panelling, tangentially to the rings is seen in Fig. 15. The log, instead of being cut into halves or quarters, is first cut to a square balk, which is then gradually reduced as the boards are sawn off. The deciding factors as to the method of cutting up the log are its size, the amount of sap-wood to cut off, and the presence of any particular defects of knots, shakes, or decay.

MARKET SIZES OF TIMBER

The terms given to the various size timbers in market forms are as follow: A balk varies from 12 in. by 12 in. to 18 in. by 18 in.; whole timbers from 9 in. by 9 in. to 15 in. by 15 in; half timbers from 9 in. by 4½ in. to 18 in. by 9 in.; scantling from 6 in. by 4 in. to 12 in. by 12 in.; quartering from 2 in. by 2 in. to 6 in. by 6 in.; planks from 11 in. to 18 in. wide and from 3 in. to 6 in. thick; deals from 9 in. wide and from 2 in. to 4½ in. thick; battens from 4½ in. to 7 in. wide and from ¾ in. to 3 in. thick; strips and laths from 4 in. to 4½ in. wide and from ½ in. to 1½ in. thick.

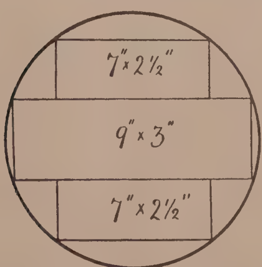


Fig. 13.—Converting Fir Log to "Deals"

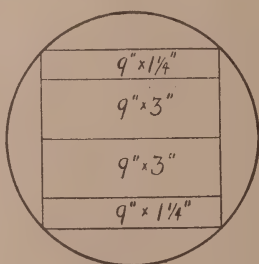


Fig. 14.—Converting Fir Log to "Deals"

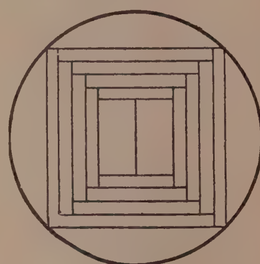


Fig. 15.—Converting Pitch-pine Log to Panelling

Pine and spruce timbers are sold by standard hundred, by the load, and by the

square of 100 ft. super. The Petersburg standard is 120 pieces of 6 ft. by 11 in. by 3 in.; the Christiania standard is 120 pieces of 11 ft. by 9 in. by $1\frac{1}{4}$ in.; and the London standard is 120 pieces of 12 ft. by 9 in. by 3 in. Calculating the volume of timber in the Petersburg standard, which is the one in general use, gives 165 cub. ft., so that the 120 pieces are equal to a balk 12 in. by 12 in., 165 ft. long. When buying timbers of other sizes this method of calculating is convenient. Supposing scantlings were brought, 9 in. by 4 in., it will be seen that this section of 36 sq. in. is one-fourth the area of the section of the balk, 12 in. by 12 in.; therefore, to make the standard the length would be four times as long as 165, which is 660 ft. A load is 50 cub. ft., so that $3\frac{3}{10}$ loads make a Petersburg standard.

Boarding is generally reckoned by the standard of 100 ft. super., so that the length of boarding required to make 100 sq. ft. varies inversely as its width, that is, the narrower the boarding the greater the length will be to give the standard area. This area is equal to 100 ft. of boarding 1 ft. wide, or if it were 6 in. wide these will be 200 ft. in length. Boarding, however, is generally sold in widths of 7 in., 9 in., and 11 in., which must be brought to the fraction of a foot so as to divide into the area of 100 sq. ft. For instance, 7 in. = $\frac{7}{12}$ ft., 9 in. = $\frac{9}{12}$ ft. 11 in. = $\frac{11}{12}$ ft. $100 \div \frac{7}{12} = 100 \times \frac{12}{7}$ = $171\frac{3}{7}$ ft., the length of boarding required 7 in. wide.

When buying timbers by any other standard of measurement the cubical contents or volume can be obtained from the measurement given.

"Mixed timber" implies defective deals from the first quality mixed with seconds.

Fir timber, sometimes imported as "hand masts," is the longest, soundest, and straightest trees when topped and barked, circumference from 24 in. to 72 in. "Spars and poles" have a circumference less than 24 in. at the base. "Inch masts" are those having a circumference of more than 72 in., and are generally dressed to an octagonal form. "Ends" are less than 8 ft. long. Scaffold and ladder poles are from young trees of larch and spruce, and average 33 ft. long. Rickers are about 22 ft. long and under $2\frac{1}{2}$ in. in diameter at the top end.

Calculating Contents of Timber Logs.—When measuring log timber, either round or square in section, it is quite customary to multiply the length of the log by the square of a quarter of the girth

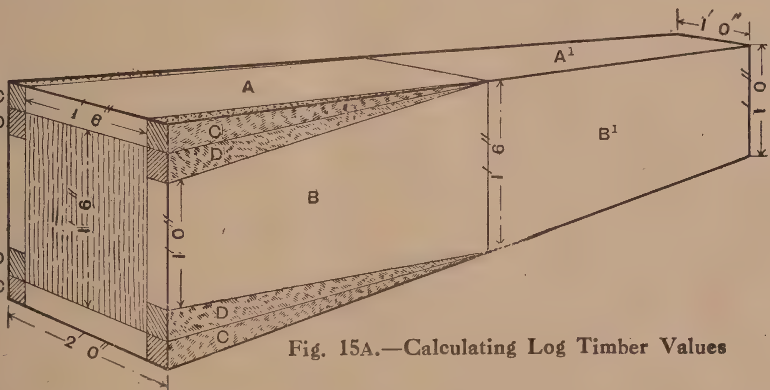


Fig. 15A.—Calculating Log Timber Values

—the girth being taken at the middle of the log.

For example, suppose a log measures 20 ft. long and is 8 ft. in circumference at the centre of its length; then, a quarter of 8 ft. equals 2 ft., and 2 ft. multiplied by itself (or squared) equals 4 ft., and this multiplied by the length of the log gives the cubical contents as 80 ft.

This method of measuring — shortly expressed by the formula $L \times \left(\frac{\text{girth}}{4}\right)^2$— while being quite proper for some forms of timber, is by no means accurate when applied to all forms; it, however, has the great advantage of being simple to work and easy to understand. Even in those cases where this rule does not properly apply, the approximate result that it gives

is often of greater value to the timber merchant than would be a solution arrived at by calculating the areas of circles, or by reducing logs from pyramidical to imaginary rectangular forms.

With circular tree-trunks that do not taper, the actual contents may be found by employing the formula $L \times \frac{\text{girth}^2}{4\ \pi}$; but calculations involving the use of π are troublesome, to say the least, and, should the log taper considerably, the difficulty of determining the actual contents by this method becomes greater still. Moreover, the actual contents of round timber, whether parallel or tapering, is always a fictitious quantity in the eyes of a timber buyer.

Considerable waste must occur during conversion, and the question really is, not how much stuff does the log contain, but how much of it is realisable. Thus, for example, a round log 20 in. in diameter equals 314 sq. in. in sectional area; but, converted into a square log, the sectional area will equal only 201 sq. in., which more nearly represents to the buyer the timber value of the log. This loss in conversion, amounting to at least one-third of the original bulk of the log, happens only when the squaring is done by axe.

If the logs are sawn square, the slab pieces are then of some value, and the actual loss will not be more than about one-fifth of the original bulk. Now the quarter-girth method of measurement (on preceding page) places the contents of a round log without taper about one-fifth lower than they really are; compared with accurate measurement in the above instance the result is as 1·00 is to 1·24 . . ., and gives very approximately the merchantable contents of the log. Not only is this method the safest to follow in connection with the measurement of round timber, but, as the form of any timber to which it may be applied more nearly approaches parallelism and squareness, so the results become more and more accurate, until, with perfectly square and parallel timber, the quarter-girth method gives a perfectly accurate result.

Applied to square tapering logs, the quarter-girth method, though not quite accurate, is still approximately correct and fair in its results. Taper in a log invariably means loss to the buyer; more taper means more loss. As if to compensate for this drawback, the quarter-girth method of measurement gives a contents result that is proportionately lower and lower as the taper in a log increases. So that here again, while the actual contents may, of course, be readily determined by considering the log as the frustum of a pyramid, the answer so afforded is often not so desirable nor so useful to the purchaser as one that more nearly represents the converted working possibilities of the log.

The diagram (Fig. 15A, p. 191) is intended to show the amount of material that is neglected or given to the buyer when such a piece is measured by taking the quarter-girth at the centre as a basis. The log represented is supposed to taper uniformly from 2 ft. at the large end to 1 ft. at the small end. At the middle of its length the quarter-girth measures 1 ft. 6 in., but, strictly speaking, there is more than sufficient wood at the large end to compensate for deficiencies at the other.

The wedge-shaped pieces A and B (Fig. 15A), when folded back into the positions A^1 and B^1, would exactly bring the log up to a 1-ft. 6-in. side from end to end. It will be seen, therefore, that an amount of material represented by the shaded portions C and D is left unaccounted for when measuring by quarter-girth; but, as before stated, except in rare circumstances, this extra material would be no real gain to the buyer.

DISEASES AND DEFECTS OF TIMBER

Decay of timber usually commences with the decomposition of the sap-wood; this takes place in either *wet rot* or *dry rot*. Wet rot reduces the timber to a snuff-coloured powder. It may occur in the growing tree or when the timber has been placed in positions where it has become saturated with rain. Wet rot is caused most frequently by a fungus which

germinates in moist ground around the roots of a tree. This eats into the tree, feeding first on the new tissue of wood, then on the sap in the cells of the rings and medullary rays until the whole is reduced to a soft spongy mass. The rot grows until finally the tree falls because of its undermined foundation. Timber that has been partially destroyed by wet rot can be distinguished by red spots; if the decay is advanced, by dull yellow soft patches with clear white spots having a small black speck in the centre of each.

Dry rot is caused by the growth of fungi, which commences to grow on timber under favourable conditions, germinating and eating into the timber and destroying its constituents. Timbers of buildings are attacked in this way when enclosed without sufficient ventilation, and in a warm, humid atmosphere, especially if any green

Fig. 16.—Cup Shake in Log

sap-wood is left on the timber. When no visible sign of dry rot exists it may be detected by boring into the timber and inspecting the dust. Sometimes dry rot appears only in the form of reddish spots, which upon being scratched show that the fibres beneath have been reduced to powder.

To preserve timber from decay, there are several elaborate but effective methods of impregnating the pores of the wood with chemicals that resist these fungi, exclude moisture, and are proof against the attack of insects; but for general purposes, if the timber is well seasoned and well ventilated, any decay will be prevented. If the timber is exposed to the weather it should be protected by painting; tarring or charring the surface if buried in the ground. Posts should be placed in the ground in an inverted position to which they grew, so as to oppose the rising of moisture into the cells of the wood.

Dry rot is the worst and most common disease of timber. It very often attacks ground floors, built-in cupboards and other

Fig. 16A.—Cup Shake in Balk

work which is insufficiently ventilated. The remedy is to cut away the diseased parts and replace with well-seasoned timber free from sap-wood and preferably treated with creosote oil. Ventilation should be supplied so that a current of fresh air has access to all sides of the timber.

Good wood should look bright and have a fresh smell. It should be cut from the heart of a sound tree, uniform in substance, straight in fibre, free from large or dead knots. The surface should not be woolly or clog the saw; it should also have a silky lustre when planed.

Sound timber should be sonorous when struck; a dull, heavy sound denotes decay within. The wood should not be waterlogged, softened, or discoloured by being floated. Good timber should be free from the following defects:

Cup shakes (Fig. 16), which occur between the annual rings in the spring

Fig. 17.—Heart Shake in Balk

Fig. 18.—Star Shake in Balk

wood, due to the inner portion of the tree shrinking from the outer portion. This often occurs in the resinous pine and fir

trees, but they are generally very small and not a serious defect. *Heart shakes* (Fig. 17) are splits through the heart of the tree. They are often very small, but sometimes extend right across the tree. They are common with most timbers, but they can be prevented if timber is not allowed to lie too long in the log. *Star shakes* (Fig. 18) are splits radially from the centre of the tree, which sometimes increase in width to the outside. If the log is allowed to get into this state the timber is useless for planks, scantlings, etc.

Upsets (Fig. 19) are caused by the growing tree receiving a blow (say another tree falling against it). *Twisted fibres*, as in Fig. 20, are caused by the wind twisting the tree. Timber with twisted fibres is unfit for good work, as after it has been sawn to shape it has a tendency to twist back again. *Waney edges* are due to the round surface of the trunk being left on the edges of the cut plank, as in Fig. 21. *Foxiness* is a reddish or brownish tint showing that the timber is beginning to decay. *Doatiness* is a speckled stain found chiefly in beech and is a sign of decay. It is caused by unseasoned timber and by exposure for a long period to a stagnant atmosphere.

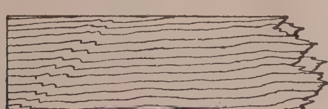


Fig. 19.—Upset

Fig. 20.—Twisted Fibres

The rain may have penetrated a hole or hollow in the bark where a branch has been cut off, or some other cause which has started decay in parts. Even when the general defects are not visible, the experienced eye can detect the inferiority of the timber by the looseness of fibres, especially on the end grain, which can be verified by testing its lightness in weight.

Fig. 21.—Waney Edges

The following lists comprise the broad-leaf woods, which are mostly hard woods, and the conifers approximating the needle-shape leaves, which are generally soft woods :—

BROAD-LEAF WOODS.

Oak	Medullary	Teak.
Beech	rays clearly	Satin Walnut.
Sycamore	visible.	Poplar.
Ash.		Bass.
Elm.		Birch.
Mahogany.		Greenheart.
Black walnut.		

CONIFERS.

White fir or spruce.	Pitch pine.
Red or yellow fir.	Cedar.
American yellow pine.	Larch.

Rasps, Files and Glasspaper

Cutting Action of a File and Rasp.—The action of a rasp or file in removing material is purely one of abrasion. It is argued that strictly speaking its cutting action is that of incision, but if this is so the well-known abrasive action of a grindstone should be included under this head. Rasping and filing is the operation of cutting by the friction between a hard medium with multiple cutting edges and the softer material it is desired to reduce. A rasp is used to remove the greater amount of the irregularities on a surface (its particular sphere of utility will be propounded later), whilst a file is used after the rasping operation for smoothing down the grain and roughness raised by the coarser action of the rasp. In order, therefore, that this result may be effected, a variation in the number as well as the formation of the teeth of a file as compared with a rasp is given to it, the file having a greater number of teeth to the inch so that each tooth has less work to do and hence removes less material.

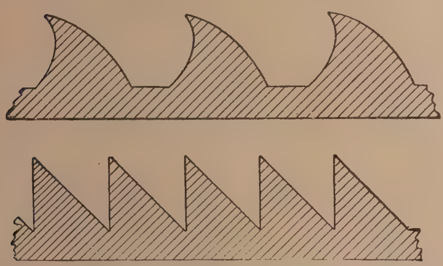


Fig. 1.—Teeth of Rasp and File Respectively

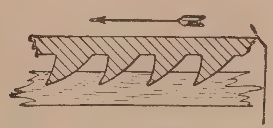


Fig. 2.—How Rasp Teeth Cut

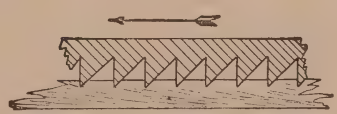


Fig. 3.—How File Teeth Cut

Fig. 1 shows the teeth formation of both a rasp and file drawn to exaggerated proportions, from which it will be readily manifest how and why a rasp gives a rough and a file a smoother finish. The semi-circular leading face of the rasp tooth gives a greater frictional cohesion between rasp and wood, which explains the resultant coarse yet rapid finish. Fig. 2 shows the rasp, as pressure is applied, taking hold of the material, and Fig. 3 a file under similar conditions. Whereas the cutting or leading face of each rasp tooth offers great resistance to motion by reason of its formation, a file more nearly approaches chisel action, which is responsible for its softer cut.

It must, of course, be understood that a wood file or rasp will not cut metal, as its degree of hardness is much lower than a metal-cutting file.

The Manufacture of Files and Rasps.—Files are both hand and machine cut, the hand cut being more expensive but of longer life than the machine cut. As has been previously explained, the formation of the teeth is decided by the purpose for which the file is intended, but in all cases the process of manufacture is the same. Bars of steel, rolled to sizes most appropriate for the size of file being made, are cut into file blanks. "Tanging" is the next operation, consisting of cutting the pointed end on which the handle is driven, and which is effected, as is the following operation of truing by a steam hammer.

The blanks are next annealed in a furnace made for that purpose, remaining therein for about three hours at a temperature of 760° Fahrenheit. The blank is then sufficiently soft to be cut. The brightening or burnishing operation follows, and is effected by either a sand-blast, grinder, or (in the case of awkward patterns) by filing. In all files having a flat face the latter has to be machine ground, when the file is ready for cutting.

The file-cutter delivers his blows (made with a 6-lb. hammer) upon a chisel ground to give the desired form to the file teeth (the blank being strapped to a block), at the rate of from 120 to 150 blows per minute; even so, no inaccuracy can be detected either in the depth or angularity of the cut. Sometimes the backs of the teeth are sand-blasted to improve the cutting qualities. The hardening is an interesting process; the file is first dipped into a brewery by-product known as "grounds," which prevents the teeth from oxidising or burning off. After heating it is plunged into a brine bath, which removes any scale formation. After scouring to clean it, the tang is tempered by dipping in a bath of molten lead.

Forms of Rasps and Files and Special Uses.—Rasps as used by the woodworker are usually of the half-round variety with one flat face (Fig. 4), whilst cabinet-makers use a somewhat finer variety, as in Fig. 5. They usually range from 6 in. to 14 in. in length, and, as previously stated, are used to remove the greater amount of unevenness—the file afterwards being used to smooth the surface down; but rasps as a general rule are seldom resorted to where a chisel, spokeshave or plane can be used. In fact, rasps are only used to give evenness to curved surfaces and others that are inaccessible to the regular truing tools, as

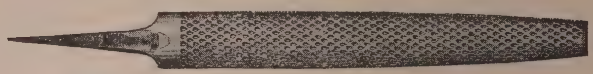


Fig. 4.—Woodworker's Half-round Rasp

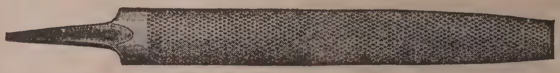


Fig. 5.—Woodworker's Half-round File

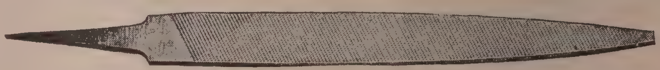


Fig. 6.—Woodworker's Flat Rasp.

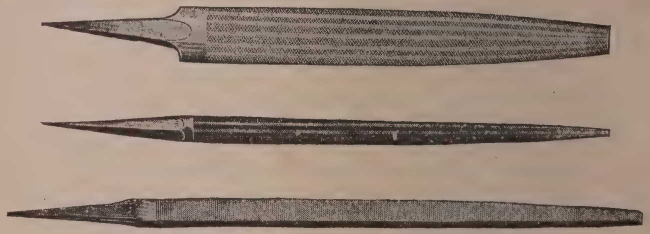


Fig. 7.—Three Shapes of Woodworker's Files

it is thereby possible to reduce the "high places" to a common level and also to operate more locally than with a spokeshave, etc. This is especially true when spokeshaving end-grain, where a cutting tool tends to cut in a series of jumps. Rasps may be purchased flat on both sides (Fig. 6), but their utility is not so general as the half-round variety.

Of the files used in woodworking the selection shown in Fig. 7 can be taken as representative; they are square, flat, half-round and round. The difference in the cut of the teeth will be noticed, files being what is known as "cross cut," that is to say, a series of intersecting cuts are made across the file; this eliminates

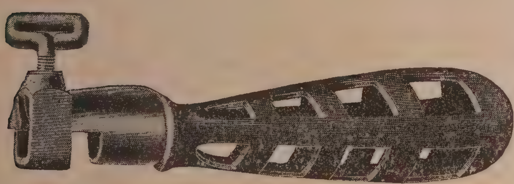


Fig. 8.—Adjustable Handle for Files and Rasps

Fig. 9.—Riffler

the tendency of single-cut files to follow the path of least resistance, viz. the direction of the cut, the cutting thrust thus being balanced. The round file is chiefly used for cleaning out holes of circular or curved form which are too small to admit a cutting tool, and similarly the square file is brought into use when a small slot or opening has to be cleaned out. Where delicate overlay or fretted work has to be finished a file is invariably used, irrespective of the size of the opening, since the lighter pressure required for filing renders the work less liable to fracture across slender connecting pieces. When end-grain cannot be satisfactorily smoothed by plane or chisel, filing is often resorted to to give a finished appearance; but generally speaking a filed surface lacks the smoothness of a planed one.

In carved or sunk work the riffler file is brought into use (*see* Fig. 9); this has its ends upturned to enable the pressure from the hand to be applied from a higher plane than that on which it is desired to operate. One end is rasp cut and the other file cut. Experience decides exactly where a file may be used—to use one where a cutting tool may be used is regarded with disfavour in the woodworking trades.

In the making of cutters for moulding planes and machines, the filing flush of nail heads, the removal of burrs, etc., which are jobs frequently falling to the lot of the woodworker, metalworker's files must of necessity be used. It is wise to select those which will cover the greatest range of work, as the infrequency with which they are used does not warrant the carrying of a full range. The "three-square" file for saw sharpening, and which has been referred to in an earlier chapter, should, of course, form part of those chosen. Plane irons, chisels, etc., are seldom made of solid steel, but have a thin steel face forming the cutting edge autogenously welded to a softer body. It saves considerable time when the chisel or plane iron requires grinding to "relieve" the softer portion with a file, leaving only the hardened cutting edge to be ground and the filed portion to be just levelled by the grindstone. An adjustable file handle (Fig. 8) which will take a variety of tangs is a useful acquisition.

Glasspaper, Sandpaper, Agate Paper, etc.—Glasspaper, sandpaper, etc., are further abrasive agents used in connection with the finishing of woodwork, but to a greater and more general extent than rasps and files. Glasspaper consists of particles of crushed glass secured to the paper by an adhesive. The crushed glass is passed through a series of screens or sieves, the various sizes of the particles thus being classified and used to form the various grades of paper. The powdered glass is shaken over the paper (which has previously been covered with glue) by means of a sieve, any superfluous powder being afterwards shaken off. Sandpaper and emery cloth are manufactured in a similar manner, differing

only in the fact that sand or emery is used in place of glass powder. Different makers adopt different methods of classifying glasspaper, but the most general scheme (from fine upwards) is 0, 1, 1½, F2, M2, S2, 2½, 3, the letters F, M, and S standing for fine, medium, and coarse in that particular grade. A fine grade, known as "flour" (owing to its fine cutting grains), is used when a fine surface is required. Glasspaper (erroneously termed "sandpaper" by many) is by far most generally used, sandpaper being almost unobtainable; glasspaper has the better cutting qualities of the two, which probably accounts for this. The M2 and 1½ sizes are commonly used, roughing down with the coarser and finishing with the finer size.

The main use of glasspaper is to prepare

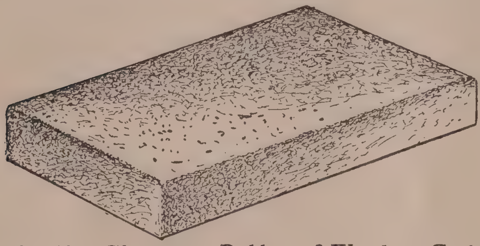


Fig. 10.—Glasspaper Rubber of Wood or Cork

a smooth surface to receive the finishing agent, which will be either polish, paint or varnish. Unless the surface were so prepared tool marks made by the plane, hammer, etc., would show through and mar the finished appearance. After the first coat of paint or varnish is applied (if this form of finish has been chosen), glasspaper is again used to remove finally the grain raised by the brush and the swelling of the grain. As each succeeding coat of paint is applied the grade of glasspaper used should be proportionately finer, until by the time the last coat is applied the surface has become so smooth that no further abrasions is necessary. While glasspaper will effectually obliterate tool marks, it should not be used to remove a great amount of material—its function is merely to remove that small portion which the ordinary cutting tool is not sufficiently sensitive to remove.

Using Glasspaper.—In order to obtain the greatest possible service from glass-

Fig. 11.—Glasspapering Convex Surface

paper it should almost always be wrapped round a wooden block. This prevents the paper "cockling" and so cracking off the cutting particles. Moreover, the pressure from the hand is more evenly distributed and covers a wider area than when used without a block, with consequent less exertion to surface the wood.

The simplest rubber is the ordinary rectangular block (Fig. 10) of either wood or cork, round which the paper is wrapped; its usual size is in the neighbourhood of

Fig. 12.—Glasspaper Rubber in Use

5 in. by 3 in. and 1 in. to 1½ in. thick. Sometimes a wooden block with a linoleum pad (Fig. 13) glued on the bottom is used. It is used in line with the grain

of the wood except in certain circumstances when it may be used across grain; in the latter case the marks of the glasspaper are much more noticeable. Patternmakers frequently surface their woodwork by rubbing first across grain, and finally with the grain. For work that is to be painted the wood may be papered at an angle of 45° across grain. The sharp edge on a piece of woodwork should be preserved and not rounded by the glasspaper.

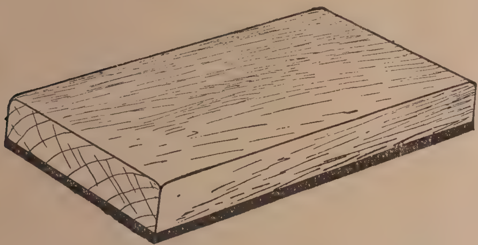


Fig. 13.—Glasspaper Rubber Soled with Linoleum

Sometimes when mouldings have to be glasspapered a rubber of wedge formation (Fig. 14) is used to work into the inner angles, while curved moulding surfaces should have a rubber made to the proper contour. For an elaborate moulding a number of rubbers to fit the various "members" may be used. Convex edges (Fig. 11) may be glasspapered without a rubber by using the hand as shown.

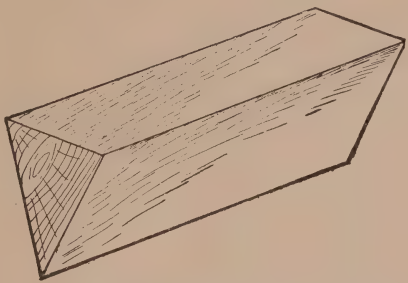


Fig. 14.—Wedge-shaped Glasspaper Rubber

There are many mechanical devices for glasspapering, such as revolving endless belts with glasspapered surface, glasspapering machines (consisting of a revolving wooden disc covered with glasspaper), and also glasspapering devices that may be used in the lathe; these will be dealt with in a later chapter.

Making Mouldings

It is often necessary to work mouldings by hand to match others already in use, or to avoid stock patterns; and as such should be worked very exact to design, they must be done systematically, or the result is a failure, and it must be admitted that the result in the majority of cases is nothing else.

In the first place, the wood from which the moulding is to be worked must be planed up properly. That is, it must be faced up truly, squared, and gauged to width and thickness just as carefully as though it was to be used for high-class joinery. On each end of the wood a true section of the required moulding must be marked, as shown in Fig. 1. After this is done, the usual procedure is to chamfer off the waste wood, as shown by dotted line; but a better way is to plough a series of grooves, as in Fig. 2, taking them quite down to the marks, so that they will form guides as to the depth of the various hollows, etc. The next proceeding should be to take off the surplus wood in the form of chamfers, bringing it to the section shown in Fig. 3, after which a very little work with hollows and rounds will bring it to the section required, and it will be the same throughout—a very important point and one not often attained.

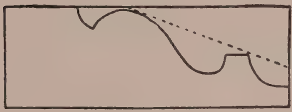


Fig. 1.—Section of Moulding to be Worked

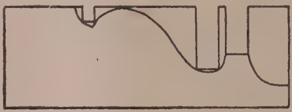


Fig. 2.—First Stage of Working

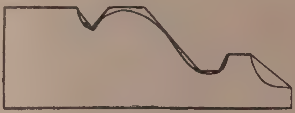


Fig. 3.—Second Stage of Working

The accompanying photographs (Figs. 7 to 9) show these several stages in the working of an actual piece of moulding made to the section for the purpose of this article, the time taken being half an hour.

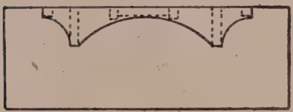


Fig. 4.

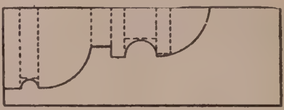


Fig. 5.

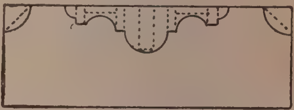


Fig. 6.

Figs. 4 to 6.—Sections of Other Mouldings; Dotted Lines indicate How the Mouldings are Worked

To ensure success, each operation should be taken down to the mark at once ; the temptation to leave a little piece on for finishing must be resisted, as it only means extra work and less satisfaction in the end.

Figs. 4, 5, and 6 show three other sections of moulding, the dotted lines showing where the necessary grooves have to be made to ensure successful work.

Curved mouldings can be worked by hand as easily as the straight ; but as planes cannot be used for these, a somewhat different procedure is necessary and this is where a scratch-tool is sometimes used.

The working of curved mouldings differs from the straight ones here described, in that it is impossible to use the plough

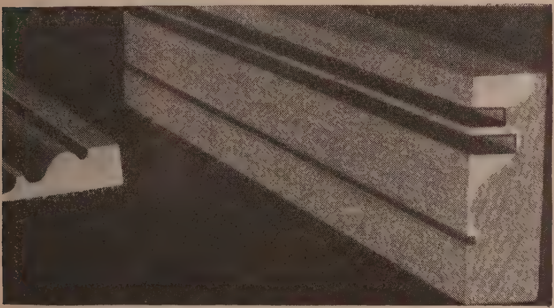


Fig. 7.—First Stage of Moulding

and rebate plane to remove the surplus wood, and it is here that the scratch-tool is found useful. The better way in making a curved moulding of any description, whether curved on plan or in elevation, or both, is to work on the woodcarving principle, that is, correctly to mark out the shape and pattern of the moulding and to cut down to the lines direct, and to clear away the surplus wood with sharp chisels and gouges. By working on this principle the wood is cut cleanly, and all that has to be done to get a smooth finish afterwards is to paper off the tool marks, which, if the tools are sharp and in capable hands, will be easily accomplished.

Fig. 10 shows a short piece of wood curved on plan, with the section of the required moulding marked on the end. Three parallel lines are also shown on the flat surface to serve as guides in what may be called outlining the moulding.

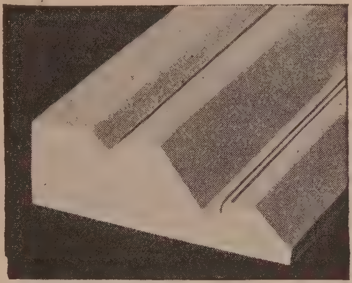


Fig. 8.—Second Stage of Moulding

Two of these lines are guides in forming the quirk of the moulding, while the other, in conjunction with one on the curved edge, forms the guide in cutting out the square portion shown white.

Fig. 11 shows the roughing out as done, the double chamfer being cut down exactly to the mark, forming a parallel vee of equal depth throughout, and the rectangular portion cut away so as to leave a level surface for the flat member of the moulding as shown. In Fig. 12 the corner of the beforementioned square is bevelled off down to the shape line, and the double chamfer altered into a hollow at one side and a round at the other, the two meeting in a sharp quirk at the bottom.

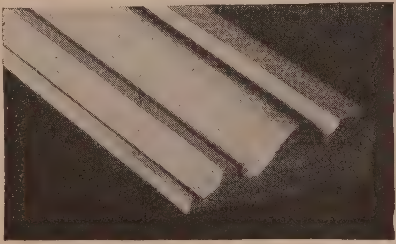


Fig. 9.—Finished Moulding

The extreme corner of the flat is also chamfered off down to the lines as a preliminary operation to forming the hollow at the thin edge of the moulding.

The hollow portion of the ogee has now to be formed with the gouge, also the hollow at the edge of the moulding, and the

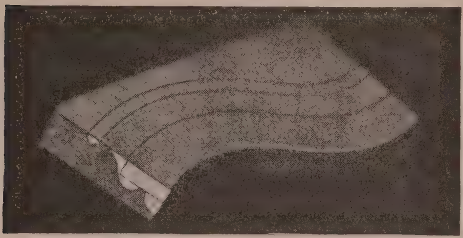


Fig. 10.—Wood for Curved Moulding, Shaped and Gauged

sharp corners on the round part of the ogee removed with a sharp chisel, when the moulding will have the appearance of Fig. 13. The finishing is done with glasspaper of not too coarse a grade, using shaped blocks, and taking particular care not to rub off the sharp corners. Providing that the shaping has been done carefully, and sharp tools used, very little papering is needed; and if care has been taken to cut to the marks and not beyond them, also to keep to the correct depths, the moulding will be found to be very even in section throughout.

Should there be small sunk members in the moulding to be worked, they should be cut down as evenly as possible, shaping the sides to the correct outline, and then to get the depth right with a level surface on the sunk portion, an improvised router

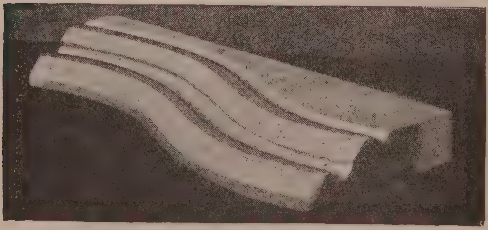


Fig. 12.—Corners Chamfered Off and Hollows Roughly Cut Out

may be formed by passing a small chisel of the required width through a piece of wood, allowing it to project to the required depth, so as to scrape the sunk part level and smooth at the same time. If the chisel is sharp and care is taken in using it, the part will be left as smooth as though it is planed.

At all times the material for mouldings which have to be worked by hand, especially curved ones, must be of good quality, perfectly dry and seasoned, free from sapwood, knots or shakes. If these points are looked after, careful work will do the rest.

On no account should the work be left a little away from the mark at first to allow for finishing. This means failure or a great deal more work to make a good job. Each successive operation must go down to the mark at once, and then the

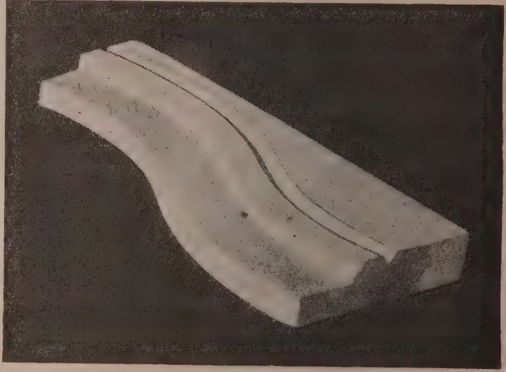


Fig. 11.—Wood Roughed Out and Small Flat Member Formed

finished article will be of correct section, and if it has to intersect with other mouldings will require no cleaning off at the joint. If this latter is needed to any great extent, good work is impossible.

The Stanley "Universal" plane is very useful for making moulding by hand. This plane is fully dealt with in the next chapter, while machines for moulding will find a place in a much later section.

Developing Shape of a Moulding Iron.—Let the shaded part of Fig. 14 represent the moulding to be worked. It will be obvious that a plane cutter made exactly as a counter-part of the moulding outline would not cut a correct replica of it, because the inclination or pitch angle of the iron would cause it to lose

its dimensions, and the depth of the moulding would be shallower and the curve also flatter than the given section.

Fig. 13.—All Hollows Formed and Mouldings Shaped Generally, Ready for Finishing

A simple experiment to substantiate this can be made. Drill a 1-in. hole in a piece of wood, and cut a 1-in. round rod to slide freely in it. Now cut the end of the rod obliquely on one end to an angle of 45° to the rod axis. The shape of this oblique end, it will be seen, is elliptical, yet every point on its circumference will touch the inside of the hole into which the rod fits. If the oblique end of the rod is imagined to be a flat plane-iron shaped similar to the oblique end (elliptical, it will be readily seen that in order to shape a circular groove with an inclined iron, the latter must be proportionately *longer* in form length.

To develop the form of the cutter, first draw the moulding section to full scale, and erect a line vertically X Y, just touching the extreme edge of the moulding. At right angles to this draw the line A B, intersecting X Y at O. From this latter point draw in the pitch of the moulding iron (this must be measured with a bevel protractor from the iron-seating in the mouth of the plane).

Now, from a convenient number of points along the curve of the moulding erect vertical lines, which are continued down until they cut the moulding-iron pitch line. With O as centre project these points with the compasses until they cut the line A B, and from the intersecting points on A B erect vertical lines.

Next transfer the points on the contour of the moulding obtained by the erection of the vertical lines cutting the pitch line, and the intersection of these with the vertical lines erected from O B gives the corresponding points of the iron. A curve drawn passing through these points gives the required shape.

It will be clearly noticed that the iron is the complementary or opposite curve of the moulding; it is obvious that the hollows in the moulding must be cut by a "round" in the iron. It should further be seen to that ordinates are erected from depth points, as L and M, for reasons previously stated.

In ordinary circumstances the pitch angle is about 45°, but for hard wood it is recommended to be flatter or less than this, the angle decreasing as the wood increases in hardness.

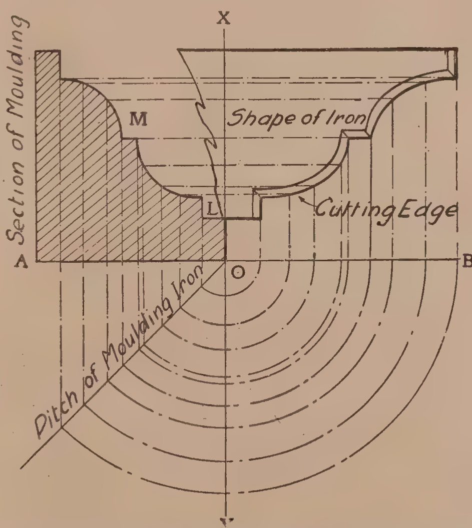


Fig. 14.—Obtaining Shape of Plane-Iron to Make a Given Moulding

The Stanley "Fifty-Five" Plane

THE Stanley "55" Plane (Fig. 1) sometimes called the Stanley Universal Plane, is a combined plough, matching, rebating, slitting, and moulding plane. Fifty-two cutters are supplied with the plane, and a further forty-one cutters may be obtained from stock. The plane is mostly made of nickel-plated metal except the handle and fences, which are of rosewood.

Parts of the Plane.—A view of the plane is shown in Fig. 1A, the important parts being designated by letters.

The Main Stock carries the cutter, cutter adjustment and cutter bolt, slitting tool, depth gauge and handle, and provides a bearing for one side of the cutter. The Sliding Section has an adjustable steel runner and gives a bearing for the other side of the cutter. It slides on the arms secured in the main stock. The adjustable runner can be raised or lowered so that cutters can be used having one side higher or lower than the side in the main stock. To form an additional bearing the Auxiliary Centre Bottom is used in connection with irregular shaped cutters, and also as a depth gauge for the matching cutters. It can be adjusted for width or depth, and when required should be attached to the sliding section.

The **Fences** can be used on either side of the plane and the rosewood faces tilted to any desirable angle up to 45 degrees. The fence to the right may be regulated by the screw for extra fine adjustment. The other fence is machined on the outside, so that when reversed it gives an extended reach for centre beading

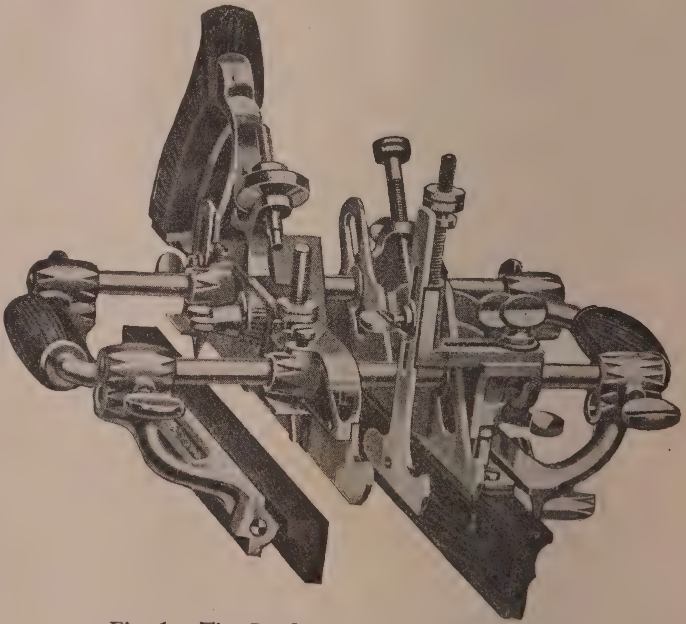


Fig. 1.—The Stanley "55" Universal Plane

wide boards. **Arms** are used to carry the fences and sliding section at the position desired. Two sets of arms (one $8\frac{1}{2}$ and one $4\frac{1}{2}$ inches long) are provided with each plane.

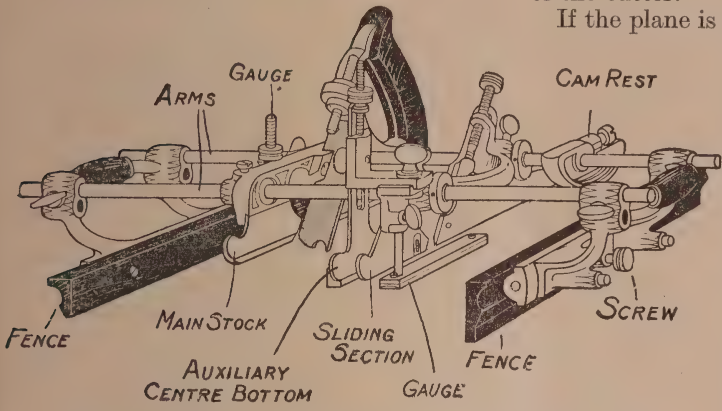


Fig. 1A.—Stanley "55" Plane with Chief Parts Named

A **Cam Rest** can be fastened on either the front or back arm between the sliding section and the right-hand fence, and acts as a rest when the fences are wide apart as in centre beading. When the auxiliary centre bottom is in use, the cam rest provides additional support when required and should be placed on the rear arm.

The Fences.—The fences are of metal with adjustable rosewood faces attached to form the bearing surfaces, and are used to guide the plane along the work. The plane should stand at an exact right angle to the edge of the work as in Fig. 2. To ensure this the rosewood faces must be adjusted to come parallel with the *side* of the cutter.

If the plane is tipped as shown in Fig. 3 the groove will work away from the fence as it goes deeper, and owing to the wood acting as a wedge between the cutter and the fence, the plane will bind. If tipped as shown in Fig. 4 the groove will work towards the fence as it goes deeper, thus forcing the fence away from the wood. The grooves made are indicated by the dotted lines in the two figures, and show that good work is impossible under these conditions.

The rosewood faces are attached to the metal fences by means of two machine screws, consequently any slight variation from a right angle can be readily overcome by simply loosening these screws and changing the angle of the faces—taking care to see that the screws are tightened when the faces are properly adjusted. Special forms can be attached to the rosewood faces if desired.

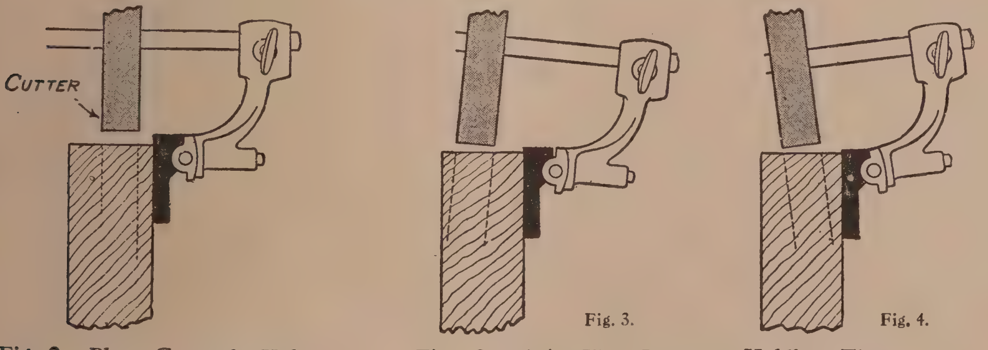


Fig. 2.—Plane Correctly Held at Right Angles to Work

Figs. 3 and 4.—How Incorrect Holding (Tipping) of the Plane Causes Grooves to be on the Slant

The fences are provided with upper and lower arm-holes. The upper holes allow the fences to slide under the cutter

to regulate the width of cut required—as in rebating. The lower holes can be used where the work is such as to require a narrow fence.

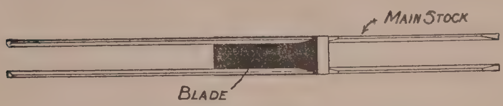


Fig. 5.—Square-edge Cutter on Runners

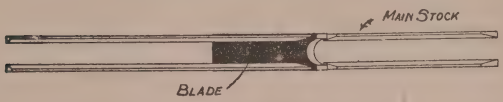


Fig. 6.—Beading Cutter on Runners

Fig. 7.—Fluting Cutter on Runner

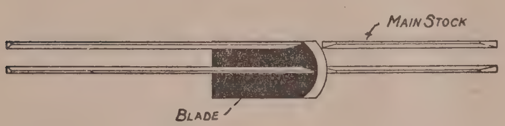


Fig. 8.—Round Cutter on Runners

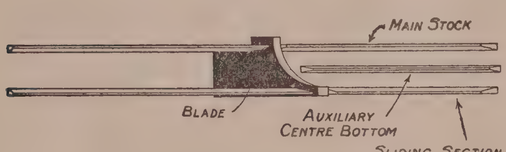


Fig. 9.—Ogee Cutter on Runners

It is advisable to use both fences where possible, as by so doing the plane may be kept true to the work with slight effort. Where only one fence is in use, care should be taken to see that it is kept close up to the edge of the stuff being worked.

The Runners.—These are thin plates of steel attached to the main stock and the sliding section, and are used to form the bearings for the cutter. For the purpose of illustrating their proper position when in use, bottom views of these runners set to use cutters of various forms are shown.

When a square edge cutter or beading cutter (Figs. 5 and 6) is used, the main stock and sliding section runners are both required. With the fluting cutter (Fig. 7) the main stock runner only is needed, the cutter being recessed on one side so that the runner will come to its highest point. In using a round cutter (Fig. 8) both main stock and sliding section runners are required, the sliding section being set to the centre of the cutter and its adjustable runner set to govern the thickness of shaving to be removed. The auxiliary centre bottom is not required for the cutters shown in Figs. 5 to 8.

With an "Ogee," or any cutter that has an irregular cutting edge, with one side extending below the other (Fig. 9), the auxiliary centre bottom should be used to form an additional support. This auxiliary centre bottom can be readily adjusted sidewise by means of the angle iron to which it is attached, and for depth by the adjusting nut on its stem. Where the bearing surface for the auxiliary centre bottom is $\frac{1}{4}$ in. or more in width an additional support called a sole plate is furnished, to be attached to the bottom of same.

Cutters and Depth Gauges.—Near the upper end of each cutter a slot or hole is made to engage with a pin located near the end of the adjusting screw on the main stock.

The proper way to set the cutter is as follows: First—Loosen the cutter clamp (Fig. 10) and place cutter in position with slot on pin. Adjust by means of

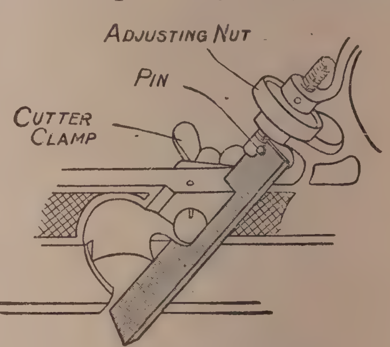


Fig. 10.—Setting a Cutter

adjusting nut, and tighten cutter clamp, then bring up the sliding section and secure it as required.

Care should be used in adjusting the sliding section where the cutter is to be

used its full width, to see that the side of the cutter extends beyond the runner only enough to give clearance (Fig. 11).

Fig. 11.—Setting Cutter to give Clearance

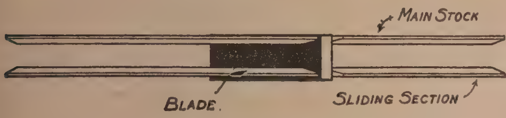


Fig. 12.—Cutter Set to give Excessive Clearance

The channel in which the cutter rests in the main stock regulates this on the right-hand side.

If too much clearance is given (Fig. 12) through allowing the sides of the cutter to project too far beyond the sliding section runner the cutter will scrape the sides of the groove, making a rough uneven cut, as well as causing the plane to

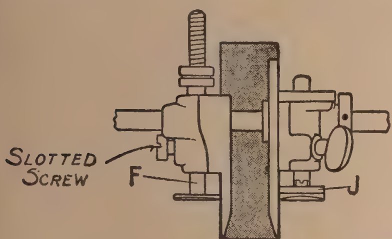


Fig. 14.—Use of Two Depth Guages

Fig. 13.—Bevelled Sides of Cutter to give Clearance

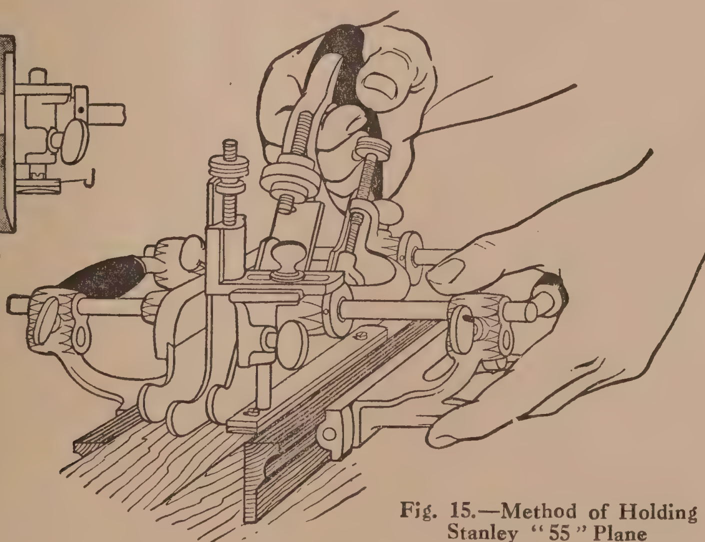


Fig. 15.—Method of Holding Stanley "55" Plane

work hard. The sides V (Fig. 13) of the cutter are given only a slight bevel, which is for clearance only and not for cutting.

As a rule it is best whenever possible to make use of both depth gauges as shown in Fig. 14, setting gauge F on main stock first and then gauge J on sliding section. Gauge F should always be clamped with the slotted screw to lock it securely in position.

How to Hold the Plane.—One of the most important points to be observed for the successful working of the plane is the way in which it is held, and the following explanation will enable the user to understand the best way in which this may be done.

As the plane is held in both hands (Fig. 15), the tendency with the beginner is to push as much with the left hand as with the right, the result being that the plane will be drawn over to the left away from the stock, making good work impossible.

The plane should be pushed forward with the right hand only, the left hand being used to keep it steady and hold the fence up to the work. The palm of the left hand should rest on the fence handle, the thumb passing over and resting on the front arm—the fingers being against the lower part of the fence. The natural tendency of the hand when holding the plane in this way is to guide it correctly.

The directions already given in regard to setting the different parts and the

various adjustments of the plane will apply for all kinds of work that it may be used for.

Rebating.—For this work insert a cutter of greater width than width of rebate wanted and move sliding section B to about $\frac{1}{4}$ in. inside the outer edge of rebate as an extra support. This will bring the sliding section inside the edge of the cutter.

Now attach the fence, putting same on the arms through the upper holes so that it will slide under the cutter the required distance to give the width of rebate wanted (Fig. 16). The depth gauge regulates the depth of the rebate.

Trenching.—As the plane has to work across the grain in trenching, "spurs" are necessary in front of the sides of the cutter to score the wood and thus prevent the tearing of the stock. These spurs are set in the sides of the main stock and sliding section.

Loosen the screws, securing the spurs so that they will drop into position (Fig. 17) with cutting edges extended beyond the runners fully the thickness of shaving to be removed, and tighten screws. Insert a plough cutter of the same width as width of trench wanted, and move sliding section up to cutter until spur is in line with its outer side. When so located there will be no danger of the cutter tearing the side of the groove.

Insert depth gauge J in sliding section, as shown in Fig. 18, and set it to regulate the depth of trench.

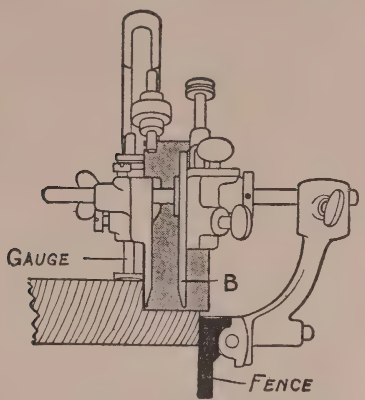


Fig. 16.—Rebating with the Stanley Plane

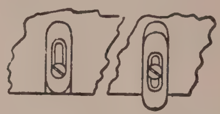


Fig. 17.—Adjusting the Spurs for Trenching

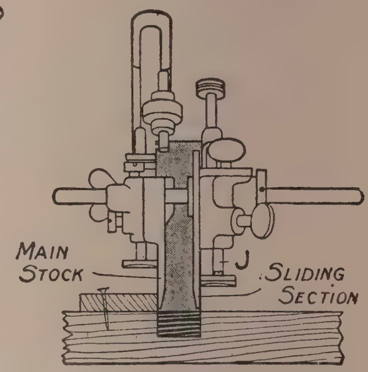


Fig. 18.—Trenching with the Stanley Plane

Nail a strip of wood on the board in which the trench it to be cut to guide the plane. The fences of the plane are not used, and should be removed unless the trench can be worked from the edge of the board.

Ploughing.—When used as a plough, set the sliding section runner as described on page 206. The width of grooves are in no way confined to the width of the cutters supplied, as it is possible to make a groove

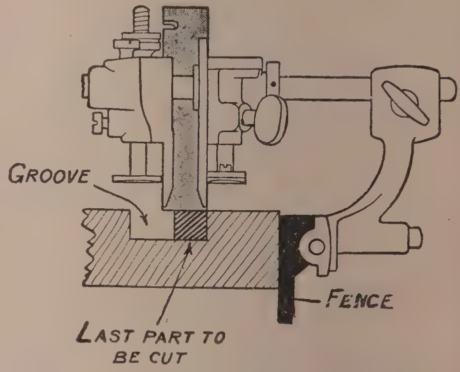


Fig. 19.—Ploughing with the Stanley Plane

of any width by working it twice or more, one cut running into the other. In making these extra wide grooves it is necessary that the fence should first be set to work to the side of the groove which

is farthest from the edge of the wood against which this fence is to bear (Fig. 19). If this is not done there will be difficulty in keeping the fence up to the

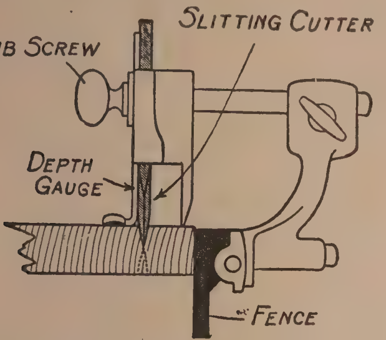


Fig. 20.—Slitting with the Stanley Plane

wood when running the second part of the groove.

It is also best to use a cutter of comparatively narrow width when making extra wide grooves, instead of a cutter nearest to the width of the finished groove, as in making the last cut the cutter has a tendency to "run off" where there is only a narrow strip left to be taken from

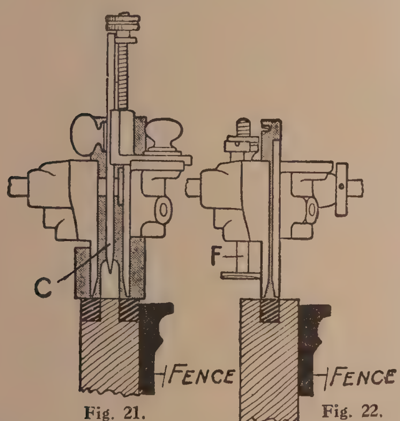


Fig. 21. Fig. 22.

Figs. 21 and 22.—Matching (Tonguing-and-grooving) with the Stanley Plane

the side of the groove. The two depth gauges should be used in work of this kind, or the bottom of the groove may finish unevenly unless more than ordinary care be taken.

Slitting.—(*See* Fig. 20.) For cutting strips from thin boards a cutter is provided which will perform the work more rapidly than if a saw were used. The slitting cutter is inserted in a slot on the right side of the main stock just forward of the handle. The depth gauge is placed over the blade and both cutter and gauge fastened by the thumb-screw. The fence gauges the distance of the cut from the edge of the board.

Thicker boards can be cut by first running the cutter partly through on one side, reversing the timber, and completing the cut on the other side.

Matching.—To make a tongue on boards of any thickness from $\frac{3}{4}$ in. to $1\frac{1}{4}$ in., a tonguing tool or cutter is provided.

This cutter is recessed on one side so that if used on either a thin or thick board the runners may still be kept on the wood when regulating position of tongue (Fig. 21).

The auxiliary centre bottom C is used as a depth gauge to regulate the height of tongue. The position of the tongue is regulated by the fence.

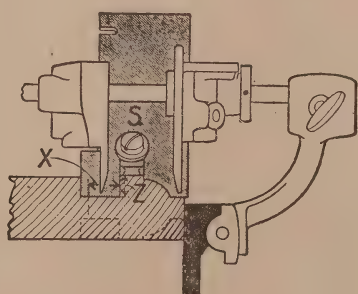


Fig. 24.—Sash-moulding with the Stanley Plane

Fig. 23.—Section of Double-tongued Joint

To make the groove use the $\frac{1}{4}$ in. plough cutter. The fence regulates the distance of groove from face of board and gauge F the depth (Fig. 22).

If double-tongued joints are wanted, as in Fig. 23, they may easily be worked by using plough cutters to make both members.

Sash Moulding.—For this work a cutter of a design known as "Ovolo" is provided which carries its own depth gauge S, secured in the required position by means of a set screw on the gauge (Fig. 24).

The moulding can be worked on a strip of wood of the necessary width and thickness by cutting one side first, then reversing the strip and repeating the operation on the other side. When worked in this way the depth X of the rebate of the moulding is regulated by the fence and the width Z by the gauge S on the cutter. The other portions of the moulding are fixed by the shape of the cutter.

A more satisfactory way, especially for ease in holding the timber, is to work the moulding on the two sides of a board of suitable thickness. The depth X will here be obtained by cutting off with a slitting cutter or saw.

Beading.—Fig. 25 is an illustration of the plane with a beading cutter inserted, and the fence properly set for the working of an ordinary bead.

To cut a bead on the edge of a board, bring up the sliding section so that the bevel of the runner will allow the cutter to take off a shaving of the same thickness as that on the side in main stock (Fig. 26). This bevel will allow only the thinnest shaving possible to be taken off by the part of the cutter forming the quirk.

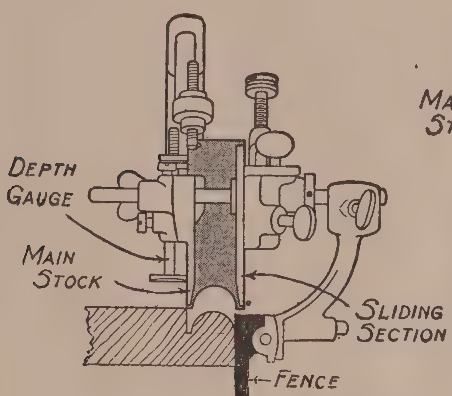


Fig. 25.—Beading with the Stanley Plane

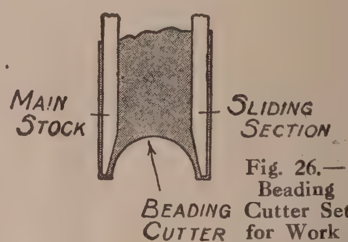


Fig. 26.—Beading Cutter Set for Work on Edge of Board

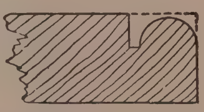


Fig. 27.—Finishing Bead below Surface of the Wood

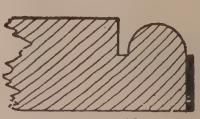


Fig 28.

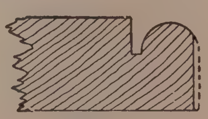


Fig. 29.

Figs. 28 and 29.—Badly-formed Beads

The fence must be set so that it comes exactly to the inner point of the cutter, as shown in Fig. 25. This will bring the outside face of the bead to the edge of the board. Set the depth gauge on the main stock so as to allow the bead to be worked down to the proper depth below the surface of the wood.

It is always advisable when working beads and similar mouldings to finish them well below the surface of the wood, so that any subsequent cleaning off the surface will not change their form (Fig. 27).

The bead should appear in section as Fig. 27, the round gradually merging into the straight without a break.

The first attempt may result in a bead, as shown in Fig. 28, necessitating the planing off of the edge (*see* dark line) to form a perfect bead; or worse still, as in Fig. 29, which cannot be made into a properly shaped bead. The fault in the first instance is caused through the fence not being brought up to the point of the cutter; in the second instance through its being set inside the point of the cutter.

Fig. 30 shows the section of a centre bead. It can be worked at any required distance up to eight inches from the edge of the board by using the longer set of arms regularly furnished with the plane and reversing the fence. Extra long arms can be furnished on special order which will permit of a bead being

worked at even a greater distance than eight inches from the edge of the board.

When making a bead near the edge of a board the cam rest is not necessary, but when beads are made at any distance from the edge it will be found convenient and of great assistance, as it will tend to prevent the fence from sagging. It should be placed on the front arm.

Fig. 31 is a section of *reeds* worked in the same way as the bead in Fig. 30 by using the reeding cutters for small sizes, and by working a series of centre beads for larger sizes. When working centre

The working of a return bead (Fig. 34) of a good shape is often a puzzle with the ordinary wooden bead planes. With the "55" the bead is first made on the edge of the board (Fig. 35) so that a small quirk is left on the face side, as shown in Fig. 35A. The bead is then finished by setting the plane with the depth gauge so adjusted as to exactly take off this superfluous quirk on the face side and no more (Fig. 36). This will come easily, as the first part of the bead is worked true from the face side, and the depth gauge will regulate the other part from the same surface.

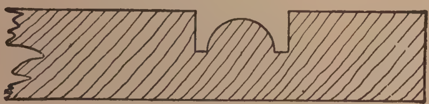


Fig. 30.—A Centre Bead

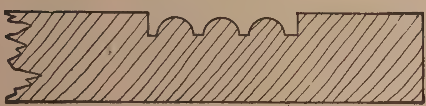


Fig. 31.—Reeds or Reeding

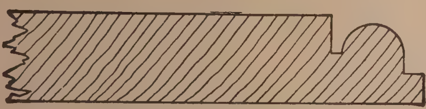


Fig. 32.—Torus Bead

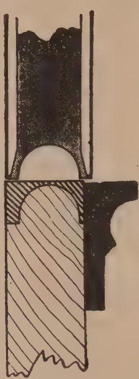


Fig. 35.—Working Bead on Edge of Board

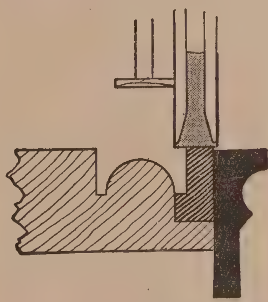


Fig. 33.—Working the Torus Bead

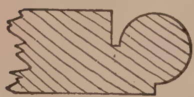


Fig. 34.—Return Bead

beads, the bead which will be farthest from the edge against which the fence bears should be worked first. If this is not done there will be difficulty in working the succeeding beads so that they will properly connect with those first made.

Fig. 32 shows a section of the "Torus" bead. This is easily worked by first forming the centre bead at the required distance from the edge of the board, and working the square or quirk with one of the narrow plough cutters. This cutter should always be the full width of the square, so that no further work is needed to level it down. A section of the plane as set to work the square is shown in Fig. 33.

Figs. 37 and 38 show sections of small mouldings which can be worked on the edges of boards of suitable thickness and then cut off to the thickness required, as shown by dotted lines. Fig. 39 shows how to make round rods of any size by working a bead from both sides of a board. If the board is of the right thickness and the depth gauge set correctly, the rods come off so as to require very little finishing.

In beading matched boards (Fig. 40) the ordinary fence cannot be used as the tongue is not always of the same width. Instead use the gauge, placing same in the socket on the front of the sliding section. The adjustable bottom on this gauge can

be moved under the sliding section runner, thus bringing the bead to the edge of the board if no quirk is desired. In either case it gauges on the edge of the work, above the tongue.

Chamfers.—For working a right-angle chamfer (Fig. 41) both fences are used, the wood faces being set at right angles and give the advantage of the fine adjustment on the fence used as a gauge. Fig. 41 shows plane assembled this way.

The width of the cutter should be a little more than the width of the chamfer. Bring the auxiliary centre bottom near the centre of the cutter and set the sliding section so as to form a bearing for the

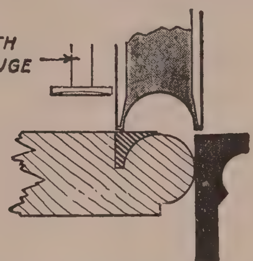


Fig. 36.—Finishing the Return Bead

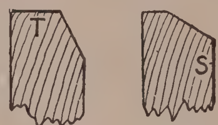


Fig. 42. Fig. 43.

Figs. 42 and 43.—Chamfers at Odd Angles

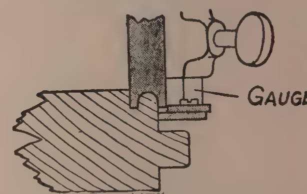


Fig. 40.—Beading a Matched Board with the Stanley Plane

Fig. 37. Fig. 38.

Figs. 37 and 38.—Making Moulded Strips by Working Edges of and Cutting Off at Dotted Lines

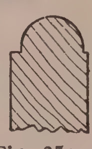


Fig. 35A.—First Stage in Working Return Bead

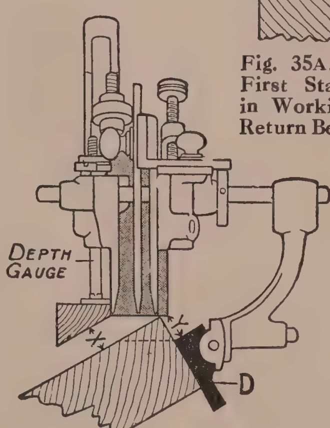


Fig. 44.—Working Chamfer at Odd Angle

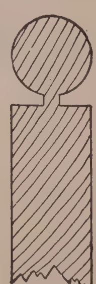


Fig. 39.—Making Round Rods by Working a Bead from Each Face

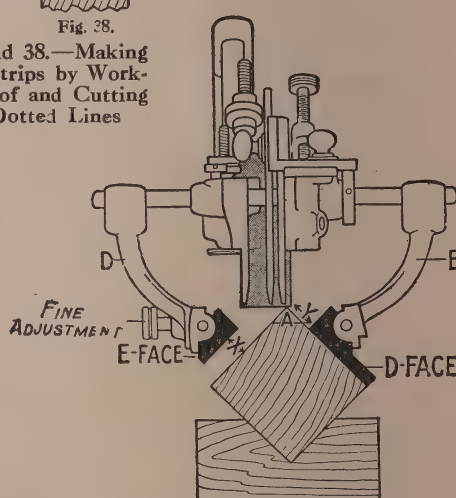


Fig. 41.—Working Right-angle Chamfer with Stanley Plane

to each other, or forty-five degrees with the cutting edge of the cutter.

Where a number of right-angle chamfers of the same size are to be made it will be of advantage to change the rosewood faces on the fences, and to change the fences, putting D on the right-hand side of the plane and E on the left. This will bring the wide face on the bearing side first cut, locating it just inside the corner of the wood A. For width of chamfer set the fence so that the distance (X) from the fence to the work will be the same as the distance (Y) from the corner of the work to the finished chamfer.

For making a chamfer at an odd angle the fences are used as regularly assembled (Fig. 1A, page 205). Set the rosewood face

on fence D to the angle required for the bevel of the chamfer (Fig. 44). Work from the edge T of boards for chamfer as in Fig. 42, and from the side (S) for chamfer as in Fig. 43. While fence E can be used to gauge the width of chamfer, better results will be obtained by using the depth gauge, attaching a wood face of proper shape to the bottom of same, as shown in Fig. 44.

Moulded Chamfers.—Arrange the plane as shown in Fig. 45, the two fences forming the bottom support and being in contact with the work at all times.

The patterns of mouldings shown in Figs. 46 to 49 can be easily worked in this way by inserting suitable cutters, all being done at one working, except Fig. 49, which is done in two.

For stop chamfering (Fig. 50), nail stops on work against which the runners will strike, thus governing the point where chamfer is to begin and end. The plane should be set and worked as for moulded chamfers (Fig. 45), using a straight cutter a little wider than the width of chamfer desired.

In working chamfers, either plain or

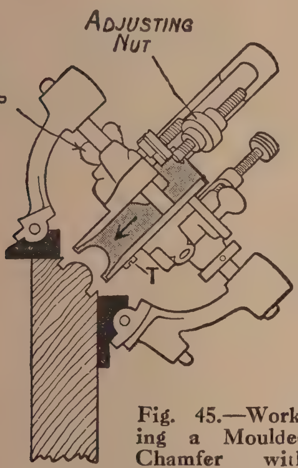


Fig. 45.—Working a Moulded Chamfer with the Stanley Plane

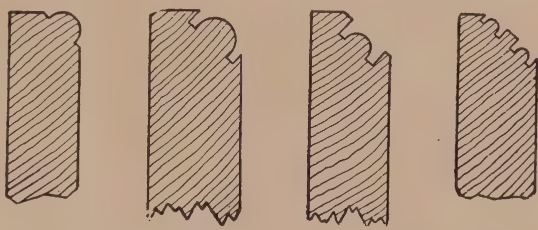


Fig. 46. Fig. 47. Fig. 48. Fig. 49.

Figs. 46 to 49.—Easily-worked Mouldings and Moulded Chamfers

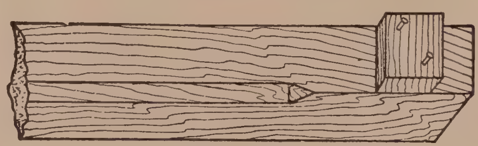


Fig. 50.—Making a Stop Chamfer

Slightly lossen the cutter clamp and draw back the cutter before starting the work.

It is necessary as the work progresses to feed down the cutter, as the moulding is made on the face of the chamfer. This can be done by slightly turning the adjusting nut between each shaving. If the fence were used as a gauge the cutter would move parallel with the face of the stock and the form of the moulding be entirely lost.

It is also necessary to give the cutter an extra support on the sliding section to prevent it working to one side. This is done by putting screw T in the sliding section runner, bringing the head close up to the cutter. This screw will be found in the main stock below the back handle.

moulded, it is best to support the wood in notched blocks whenever possible (Fig. 41). This permits of the plane being held in a horizontal position.

Hollows and Rounds.—In working *convex* mouldings or rounds the main stock and sliding section runners should be at the extreme points of the cutter (Fig. 51), when they will gauge correctly the thickness of the shaving to be taken off. In working *concave* mouldings or hollows, set the adjustable runner on the sliding section to form a bearing for the cutter at its lowest point, as in Fig. 52.

Thumb mouldings can be worked with the hollow and round cutters when curves having a rather large radius are desired. Mouldings having curves of smaller radius can be worked to better advantage with

the fluting and beading cutters. First, cut the hollow on the face of the board (Fig. 53); second, form the round on the edge of the board (Fig. 54). The auxiliary


Fig. 51.

Fig. 52.

Figs. 51 and 52—Setting Cutter for Convex and Concave Mouldings respectively

Fig. 54.—Second Stage in Working Thumb Moulding

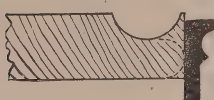


Fig. 53.—First Stage in Working Thumb Moulding

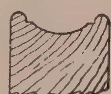


Fig. 55.

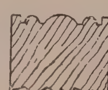



Fig. 56.

Figs. 55 and 56.—Mouldings Worked with Hollows, Rounds and Beading Cutters

centre bottom should be used in finishing the round or bead.

The two mouldings shown in Figs. 55 and 56 are worked with the hollow and round cutters and beading cutters. In working mouldings such as Fig. 57, the depth gauges and fence can be readily set so as to bring the concave and convex parts of the moulding together, and the correct section accurately obtained.

The mouldings shown in Figs. 58 and 59 are worked from both edges of the board, being careful to work the member farthest from the edge first. In Fig. 60 the face of the moulding must first be worked to the required curve, but not to a fine finish, and then the rounds worked, as in Figs. 58 and 59, changing the wood face on the fence to the proper angle. Fig. 61 can be worked by using one of the fluting cutters; and Fig. 62 is simply a repetition of Fig. 60 in reverse order, worked in the same way.

Mouldings.—In working all mouldings it is of the utmost importance that the fence be kept firmly to the wood, but particularly so in working quarter hollows (Fig. 63), owing to the tendency of the cutter to force the fence away from the wood, due to the fact that the runners come partly on the curve of the moulding. In mouldings of these forms the auxiliary centre bottom can be used to advantage as an additional support, especially on large mouldings.

With reasonable care, and setting the cutter so that it only takes off a thin shaving, one will find little if any difficulty in forming perfect mouldings. By setting the fence so as to leave a narrow strip of wood between the fence and the cutter, as shown in diagram of Roman ogee (Fig. 64), the plane will be much more easily held up to the work. Having completed the moulding, the extra material can be removed with an ordinary plane.

Reverse ogees (Fig. 65) and quarter rounds (Fig. 66) having squares or quirks

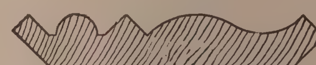


Fig. 57.—Moulding Requiring Careful Setting of Gauges and Fence

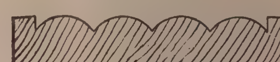


Fig. 58.

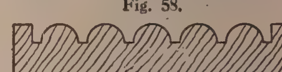



Fig. 59.

Figs. 58 and 59.—Mouldings Worked from both Edges of Board

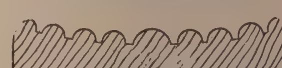


Fig. 60.—Mouldings on Board of Concave Section

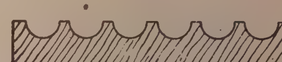


Fig. 61.—Moulding Worked with Fluting Cutters

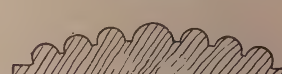


Fig. 62.—Moulding on Board of Convex Section

to deal with can be readily worked without leaving any extra material, as shown in Fig. 64.

In working the quarter hollow with bead (Fig. 67) and the Grecian ogee

(Fig. 68), the sliding section should be brought to the inside of the bead; the bead serving to hold the fence up to the work.

It is possible to make quarter hollow (Fig. 69), but first the part shown by dotted lines must be rebated out and the fence set at exactly the right position to bring the cutter to the angle.

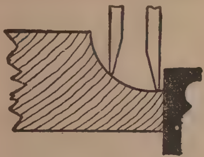


Fig. 63.—Working Quarter Hollow

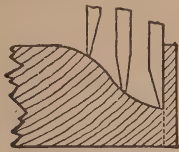


Fig. 64.—Working Roman Ogee

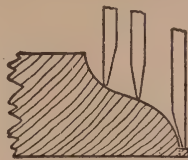


Fig. 65.—Working Reverse Ogee


Fig. 66.—Working Quarter Round

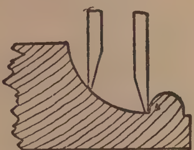


Fig 67.—Working Quarter Hollow with Bead

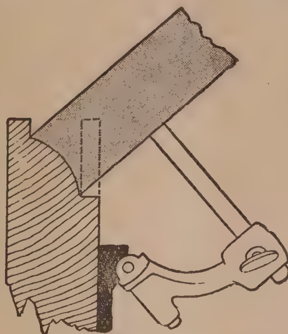


Fig. 69.—Working Quarter Round on Angle

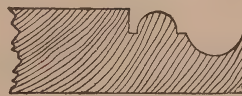


Fig. 70.

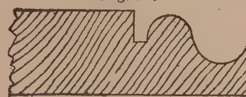


Fig. 71.

Figs. 70 and 71.—Mouldings Worked with Bead and Fluting Cutters Combined

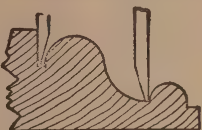


Fig. 68.—Working Grecian Ogee

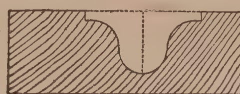


Fig. 72.—Deep Moulding Worked with Two Roman Ogee Cutters


Fig. 73.—Small Moulding Worked with Quarter Round and Bead Cutter

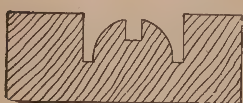


Fig. 74.—Moulding Worked with Plough and Beading Cutter

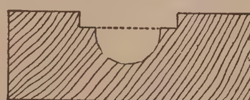


Fig. 75.—Moulding Worked with Wide Plough and Fluting Cutter

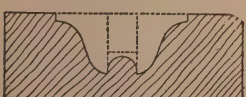


Fig. 76.

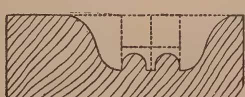


Fig. 77.

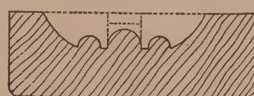


Fig. 78.

Figs. 76 to 78.—Various Mouldings Worked with Ogee and Bead Cutter


Fig. 79.—Moulding Worked with Two Grecian Ogee Cutters

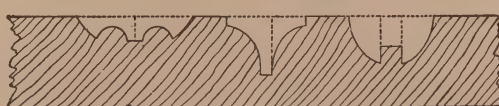
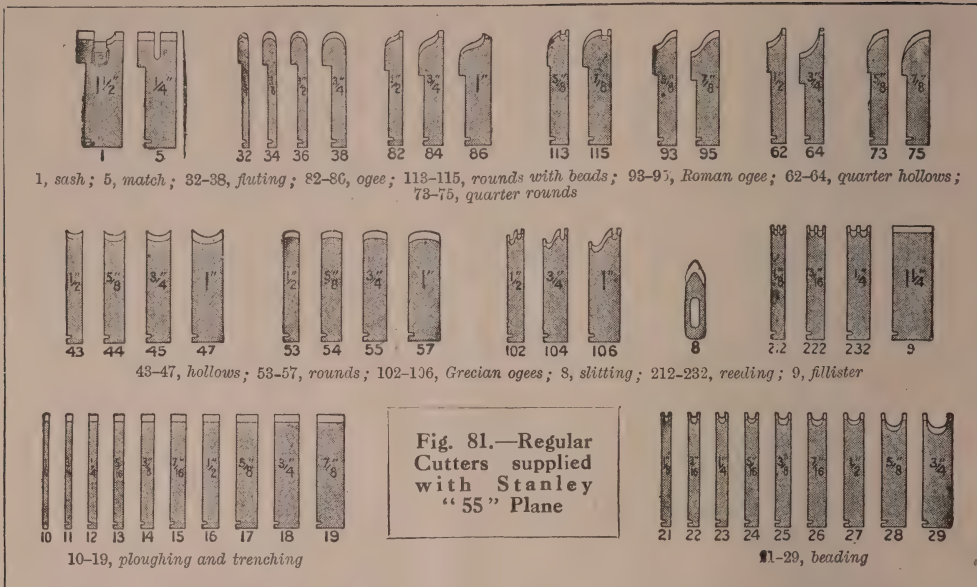


Fig. 80.—Various Combination Mouldings

and quarter round mouldings of practically any shape and size and to any angle by using a hollow or round cutter of suitable size and curve and setting the rosewood face of the fence to the angle desired

While the working of mouldings, requiring two or more operations to complete, is easy, care must be used in setting the fence and depth gauges in order that the different members will properly work



1, *sash*; 5, *match*; 32–38, *fluting*; 82–86, *ogee*; 113–115, *rounds with beads*; 93–95, *Roman ogee*; 62–64, *quarter hollows*; 73–75, *quarter rounds*

43–47, *hollows*; 53–57, *rounds*; 102–106, *Grecian ogees*; 8, *slitting*; 212–232, *reeding*; 9, *fillister*

10–19, *ploughing and trenching*

21–29, *beading*

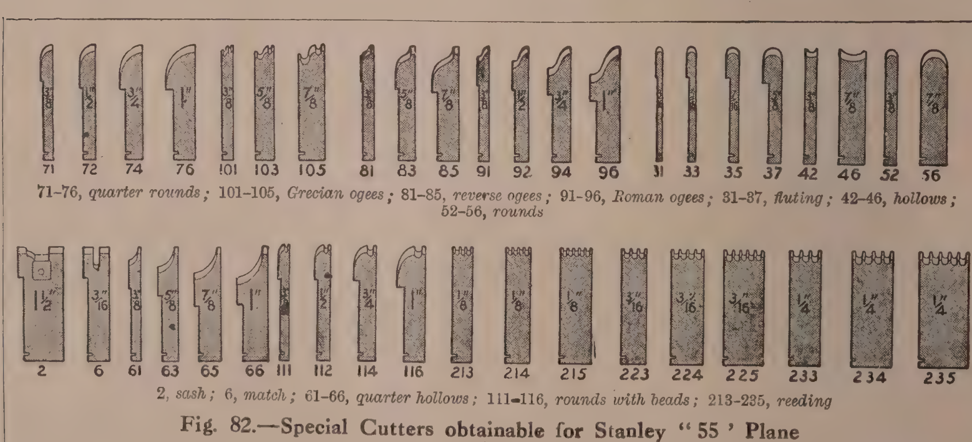
Fig. 81.—Regular Cutters supplied with Stanley "55" Plane

into each other. If this is not done their symmetrical appearance will be lost.

In Figs. 70 and 71 are shown the sections of two slightly different mouldings, both of which are formed by the use of a bead and fluting cutter in combination. The only difference in the two mouldings is that in Fig. 70 the fence is set so that the beading cutter will leave a small square or quirk between the members, and in Fig. 71 the fence is set so the two members will join without a quirk, thus forming a continuous curve.

Fig. 72 shows a deep moulding of rather unusual section, made by using one of the Roman ogees from one edge of the wood, then reversing the wood and using the same cutter from the opposite edge, being careful to set the fence so that the two grooves exactly meet at the bottom, thus forming one moulding.

The small moulding (Fig. 73) is suitable



71–76, *quarter rounds*; 101–105, *Grecian ogees*; 81–85, *reverse ogees*; 91–96, *Roman ogees*; 31–37, *fluting*; 42–46, *hollows*; 52–56, *rounds*

2, *sash*; 6, *match*; 61–66, *quarter hollows*; 111–116, *rounds with beads*; 213–235, *reeding*

Fig. 82.—Special Cutters obtainable for Stanley "55" Plane

for edges of doors and panelling in various kinds of cabinet work. It is made with one of the quarter rounds with bead, the depth gauge being used to prevent the cutter from working down to its full extent.

Fig. 74 is worked with a plough and a beading cutter. The groove should be made first, finishing with the bead. This ensures sharp corners at each side of the groove. Fig. 75 is worked with a wide plough cutter and a fluting cutter. The fluting cutter should be used to make the hollow groove first, in order that the edges of the groove will be sharp on the finished moulding.

Fig. 76 shows a moulding similar to Fig. 72, but instead of the ogees coming together, they are divided by a bead. To make this, the ogees are worked from opposite sides, keeping them far enough apart to leave the width of the bead intact; then reduce the extra wood remaining to the required depth with a plough cutter, and form the bead in the usual way. Fig. 77 is worked the same as Fig. 76, using the quarter round with bead, but not working it to its full depth. Fig. 78 is worked the same as Fig. 76, first using the ogee from opposite sides, but far enough apart to leave room for the two beads which are to be made with a regular beading cutter. Fig. 79 is made with a Grecian ogee from both edges of the work, the cutter being worked to its full depth.

Fig. 80 shows three more sections of mouldings; the first from the left being made with the quarter round with bead but not carrying the cutter down to its full depth. The middle one is formed by using the quarter hollow cutter in the same way. The one to the right by the quarter round, the fence being set so that a small upstanding square is left at the bottom. If the square is first made to the proper height with a plough cutter, thus removing some of the waste stock, the working of the quarter rounds will be materially aided.

The depth gauges form important factors in the proper working of these mouldings, as it is very evident that if these are not set exactly right the cutter will damage the first member worked. Both gauges should be used.

The examples shown are merely to give an idea of the way combination mouldings are formed, and to give the workman suggestions that will enable him to form practically any shape of moulding desired.

Fig. 81 shows the regular cutters supplied with the plane. The numbers underneath the cutters should be given when ordering cutters for this plane from the makers.

Fig. 82 shows special cutters that may be ordered by specifying the numbers. Cutters of practically any form can be used in the plane, which the operator can make from blanks or order from sketch.

All the parts of the plane are shown separated in Fig. 83. In ordering repair parts the number of the part should be given.

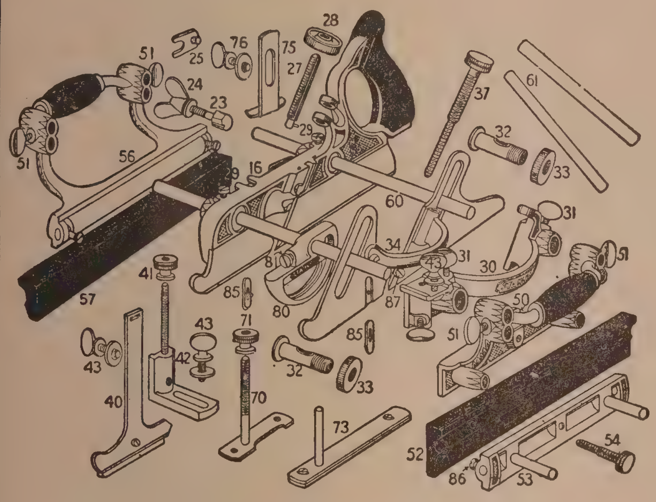


Fig. 83.—Parts of the Stanley "55" Plane shown Separately and Numbered

Halved, Lapped, Notched and Housed Joints

UNLESS woodwork joints are neatly and well made, the best after-finish cannot conceal a clumsy effect, nor can proper strength and durability be expected. The careless worker often relies on tightening with the cramp, or on slight alterations when fitting, but by far the most satisfactory and least time-wasting way is to follow sound and craftsmanlike principles from the start.

The number of different joints employed in woodworking is surprisingly large. Joiners, carpenters, cabinet-makers, wheelwrights and many other trades each have their own favourite methods, and, oddly enough, often have distinctive ways of making what is really the same joint. Even national variations are met in the work and tools of one country as compared with another.

It is here proposed to deal with many descriptions of jointing in such detail as to be practically helpful. Fully illustrated instructions will be given for constructing all the ordinary kinds of joints employed by skilled artisans, besides numerous others of an unusual and unique type.

Halved Joints.—Figs 1 to 17 show simple examples, in wood of rectangular section, of joints commonly met with in carpentry and cabinet work. They are very easy to make, and, in some cases are quite as suitable as more difficult joints. The straight half-lap joint (Fig. 1) can be used for lengthening posts or rails in hut-building, etc., also for forming wall plates, joists and rafters for roofs, floors, and temporary structures. It is readily set out. A marking gauge, marking knife (or pencil) and square are employed in setting out the pieces. As the name of the joint indicates, the depth of each piece cut away is half the thickness of the wood, and in cutting down with the tenon saw care should be taken to

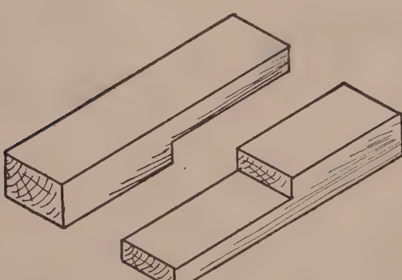


Fig. 1.—Straight Half-lap Joint

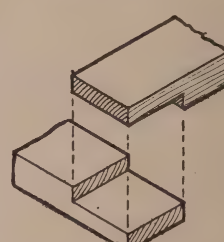


Fig. 2.—Angle Half-lap Joint

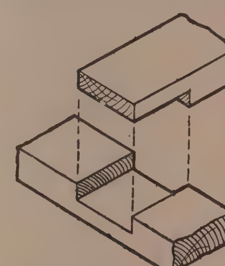


Fig. 3.—Tee Half-lap Joint

keep inside the line; the four cuts are made with a tenon saw. The terms "halved" and "lap" are often used interchangeably; but, as a matter of fact, while a halved joint is always a lapped one, a lap joint is not invariably

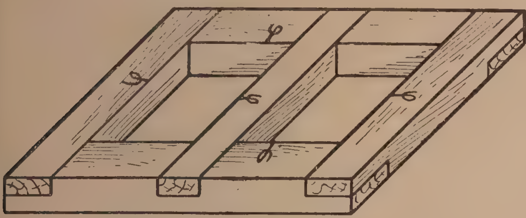


Fig. 4.—Lapped Frame with Tee-stretcher

halved. Fig. 2 shows the angle half-lap joint, suitable for corners or angles in framework, and in framed grounds for the fixing of joinery.

Tee and Cross Half-lap Joints.—The Tee half-lap (Fig. 3) is useful where a rail meets a post, or post meets sill, in the framework of huts. Fig. 4 shows a square frame halved at the angles, and with a Tee stretcher fitted at the middle. The sinking for the Tee joint is marked out for the width and gauged for depth; then, after making the usual saw-cuts, the waste is removed with a paring chisel,

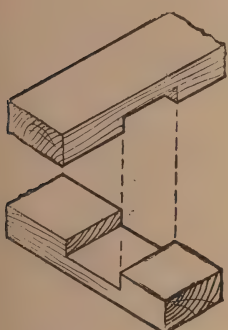


Fig. 5.—Cross Half-lap Joint

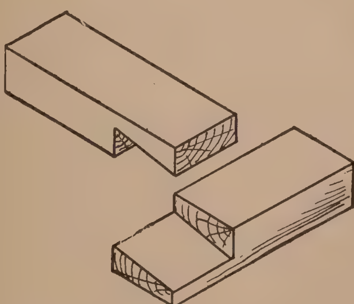


Fig. 7.—Angle Bevelled Half-lap Joint

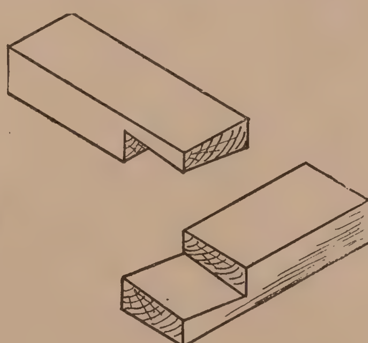


Fig. 8.—Double Bevelled Angle Half-lap

used either horizontally or vertically, as proves most convenient.

The cross half-lap (Fig. 5) is obviously a double Tee, and is very handy where pieces are required to cross each other with a flush face. A familiar instance is the Oxford frame, and the centre of a barrow-wheel may also be cited. In making Tee and cross half-joints, the parts should be gauged to a width, so that they may be set out with the cer-

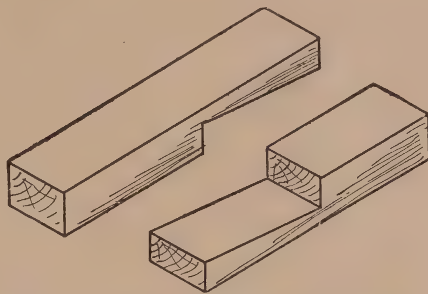


Fig. 6.—Straight Bevelled Half-lap Joint

tainty of fitting truly. When marking for the width of sinking, care must be taken that the saw kerfs are not too far apart. It is better to have the slot too narrow rather than too wide, and fit the joint afterwards by planing the opposite piece or paring the joint. But this precaution should not be depended upon to give good work. It is only suggested that it is better to have the joint a little tight rather than a little slack. The former can be remedied, but the latter cannot. The aim should be to saw the joint right first time, and so that the pieces can be fitted together "hand-tight."

Bevelled Half-lap Joints.—Examples of this useful joint are shown by Figs. 6, 7, and 8. It is occasionally employed for heavy framing work, wall plates, sills and binders, to withstand a pulling stress, also in good half-timbering for the exterior of Elizabethan-style houses. The marking down and across is similar to the simpler form of lap, but a tapered piece of wood is used as a template for the depth, instead of the gauge, though the latter is sometimes used as well, to give the right starting point for the taper.

Dovetail and Diagonal Half-lap Joints.—The dovetail half-lap may be regarded as a Tee half-lap modified to resist a lateral pull (*see* Figs. 9 and 10). It is extensively used in cabinet work. The pin part should be made first, commencing as for an ordinary lap joint, then sawing the shoulders to the necessary angle and carefully finishing with the chisel. The pin half is next held over the piece for the socket, the sinking accurately marked, as in Fig. 11, squared down, sawn sparely so as to fit the pin tightly (*see* Fig. 12), and the waste chiselled out. Fig. 13 illustrates a similar joint designed to resist an upward pull. An adaptation of dovetail and half-lap joints will be seen in Fig. 14, which

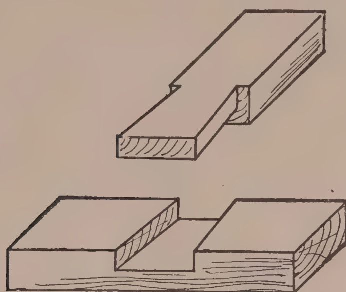


Fig. 9.—Dovetailed Tee Half-lap

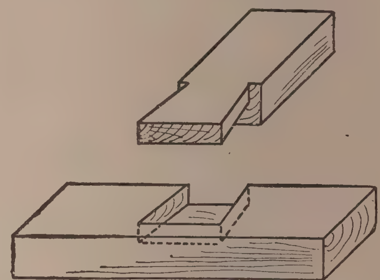


Fig. 10.—Stopped Dovetailed Half-lap

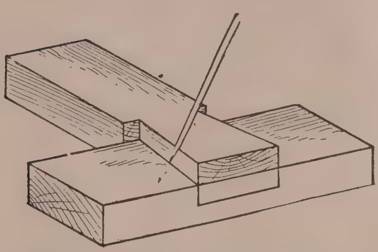


Fig. 11.—Marking Sinking from Pin

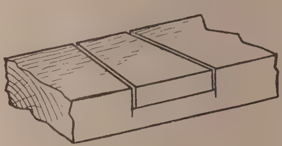


Fig. 12.—Sawing Dovetail Socket; note Saw-kerfs in Waste Wood

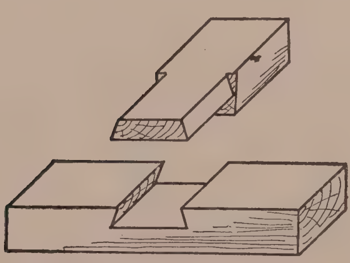


Fig. 13.—Dovetail Half-lap for Upward Pull

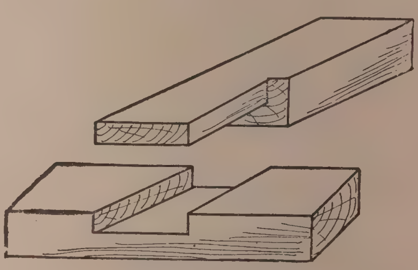


Fig. 14.—Dovetailed Acute-Angle Half-lap

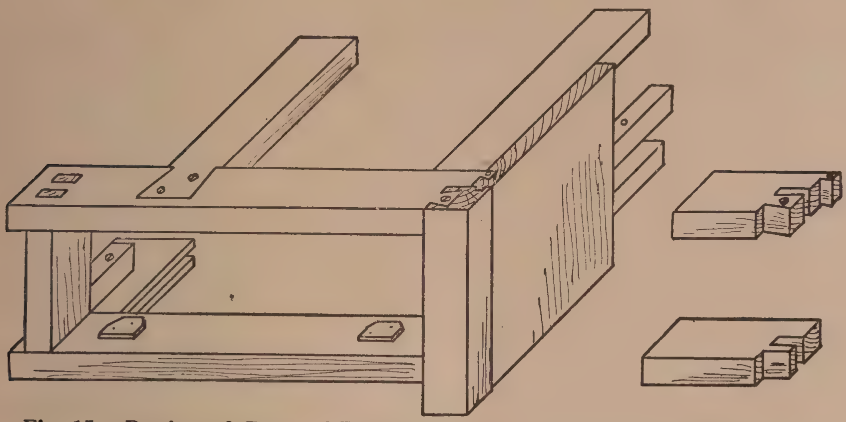


Fig. 15.—Portion of Chest of Drawers, showing Dovetail and Half-lap Joints

shows the same kind of joint as in Fig. 10, but not having the two pieces at a right angle; this is known as diagonal halving. Fig. 17 is a cross diagonal joint.

The corners of the frame illustrated in Fig. 18 are secured by bevelled half-lapping, while in the centre are two diagonal crosspieces or braces. To set out the latter, the sliding bevel is used to take the exact angle, which is then transferred to the first portion of the cross. The second piece is then laid on the first and marked in. The marked piece is now gauged for depth and cut; the other being next laid in position in the halving and marked to fit in the usual way. To insert the completed cross into the frame, one is laid on the other and the positions marked for all the cuts, the depths on both frame and cross-ends being then gauged.

In Fig. 16 we show the application of the ordinary form of the ship-lap joint (there is a more complicated form of this joint which will be described later); this is only suitable for use between two absolutely fixed posts or something similar,

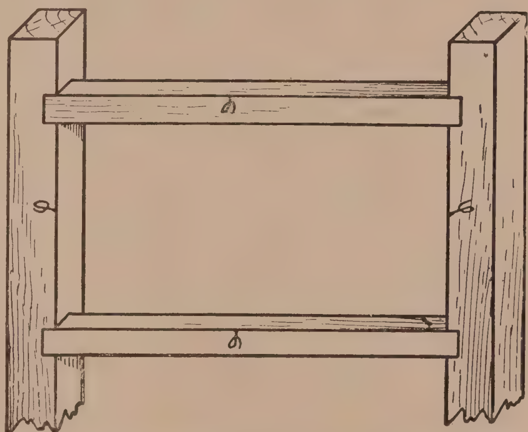


Fig. 16.—Posts and Rails with Ship-lapped Joints

but in such positions it is a handy way of fixing rails or uprights. The reason why it is necessary that the timbers between which this joint is used must be rigidly fixed is, the joint being made on the slope and fixed with nails, these latter have the tendency to force the posts or other timbers apart, thus destroy-

Fig. 16A.—Ship-lapped Joint Set Out

Fig. 16B.—Ship-lapped Joint Ready for Assembling

ing the stiffness and also opening the back part which should fit close up to them.

The ship-lap joint consists of a bevel lip fitting into a sloping recess, and the setting out is as shown in Fig. 16A, while the two parts after cutting are shown in Fig. 16B. This is really a carpenter's joint, and is rarely applicable to any other branch of woodworking, though exceptions occasionally crop up. This joint

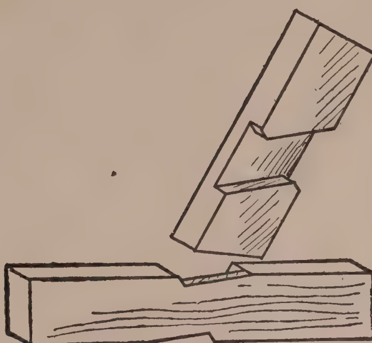


Fig. 17.—Cross Diagonal Joint

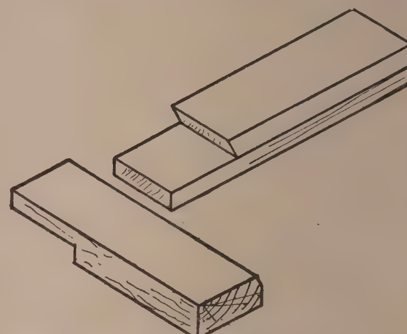


Fig. 20.—Chamfered and Scribed Half-lap

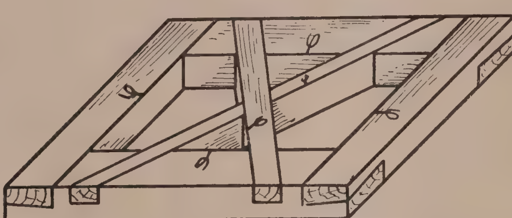


Fig. 18.—Frame with Bevelled Halvings and Diagonal Braces

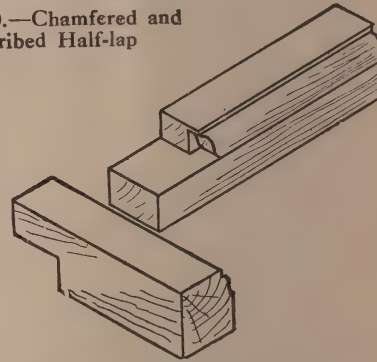


Fig. 21.—Moulded and Scribed Half-lap

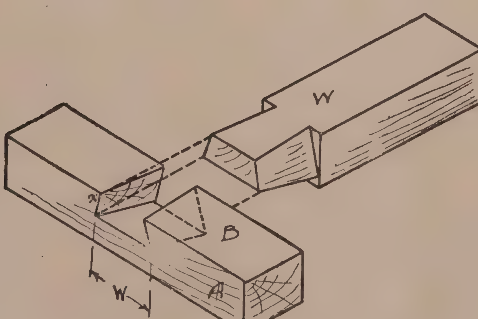


Fig. 19.—Double Dovetail Puzzle Joint

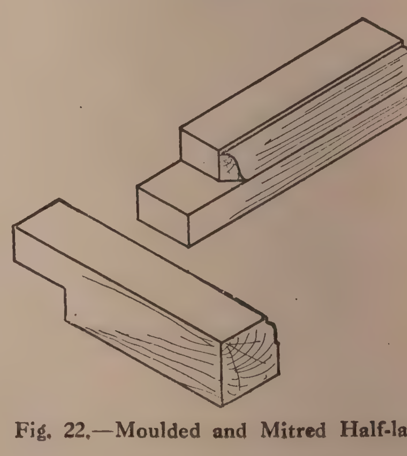


Fig. 22.—Moulded and Mitred Half-lap

is also largely localised, being very common in the south of England, but rarely seen in the Midlands and the North.

A puzzle joint, dovetailed both ways,

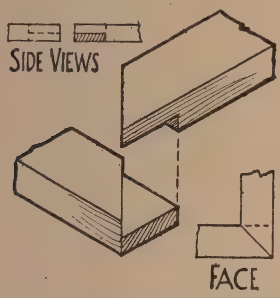


Fig. 23.—Plain Mitred Half-lap

is shown by Fig. 19. It is of the same kind as seen in Fig. 14, with the difference that the two pieces have to be separated by a slanting, downward pull; this causes the apparent dovetail on the face B. The joint is made by first gauging the edge A half-way down; on this line the width W is set out, and the dovetail is marked on faces A and B. The bevel

manner and the other piece next marked, keeping the lines full for fitting. It is as well if the joint is fitted tight. Sur-

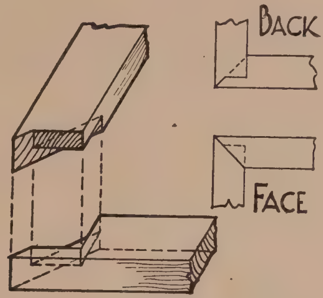


Fig. 24.—Stopped and Mitred Half-lap

prisingly many people are deceived by this joint.

Moulded and Chamfered Half-lap.—Figs. 20, 21, and 22 show moulded and chamfered pieces with half-lap joints,

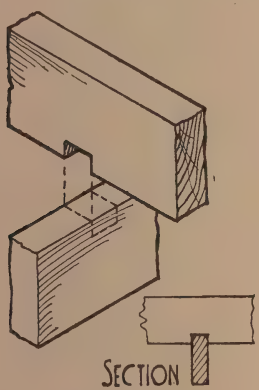


Fig. 25.—Single Notched Joint

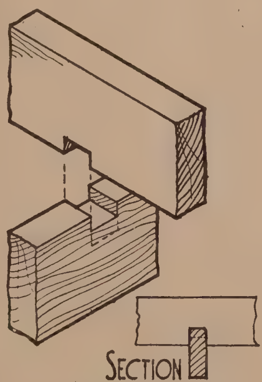


Fig. 26.—Double Notched Joint

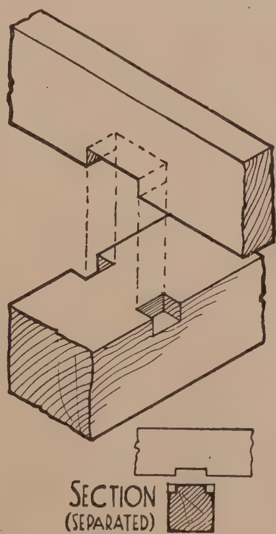


Fig. 27.—Cogged Joint

X is then transferred to the opposite edge, W is squared over to the same edge, and the work is gauged down at the point where the bevel and square lines intersect. Cutting out is done by sawing down and chiselling out the waste in the ordinary

Figs. 20 and 21 being scribed and Fig. 22 mitred. The scribing and mitreing referred to will be discussed later when dealing with mortise and tenon joints. Figs. 23 and 24 are examples of mitred half-lap joints, that seen in Fig. 24 being stopped

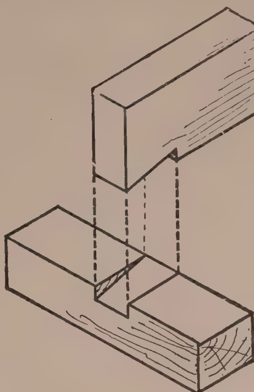


Fig. 28.—Bevelled and Notched Joint

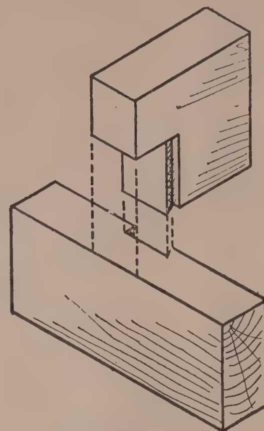


Fig. 30.—Notched and Dovetailed Joint for Joist

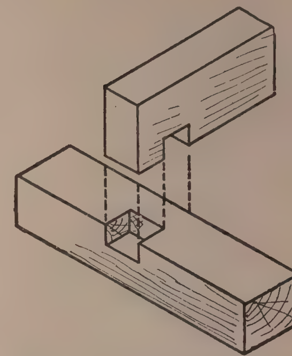


Fig. 29.—End-cogged Joint

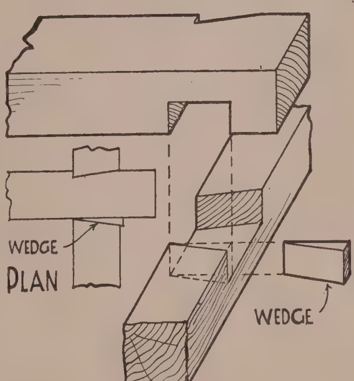


Fig. 31.—Wedged Dovetailed Notching

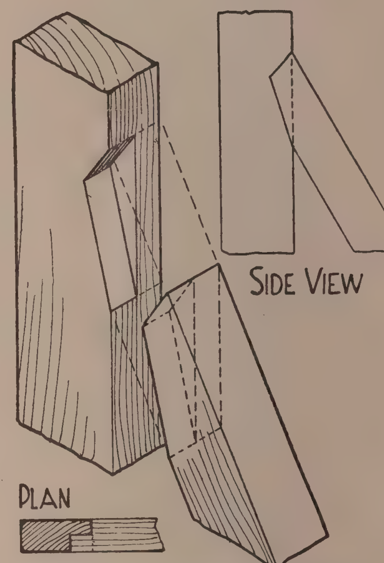


Fig. 35.—Barefaced Bridle Joint

Fig. 33.—Toe Joint

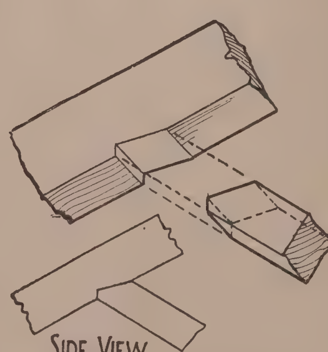


Fig. 34.—Toe Joint

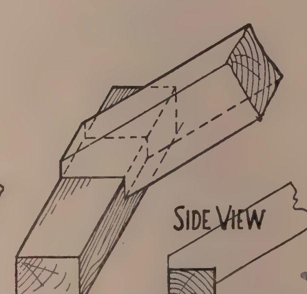


Fig. 32.—Birdsmouth Joint

to prevent the end grain of the wood showing, as would be required for picture frames.

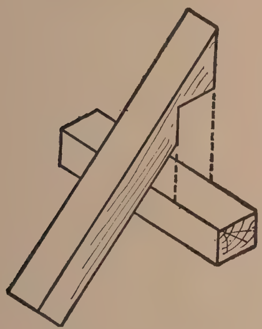


Fig. 36.—Falling Birdsmouth Joint

Fastening Halved or Lap Joints.—For securing all manner of halved or lap joints glue, nails, screws, or a combination of such can be employed. Much, of course, depends on the particular purpose, the nature of the strain to be met, and whether or not appearance has to be studied.

Notched Joints.—Numerous varieties of these are illustrated by Figs. 25 to 39. Though sometimes met with in ordinary woodworking, their chief use is in con-

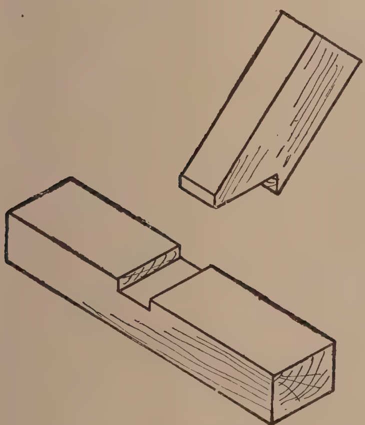


Fig. 37.—Sunk Birdsmouth Joint

structive carpentry, such as the framework of wooden buildings, cycle sheds, photographic and cinema studios etc., also in the making of rough benches and brackets. Figs. 25, 26, and 27 are examples of single and double notching, employed for fitting joists into floor

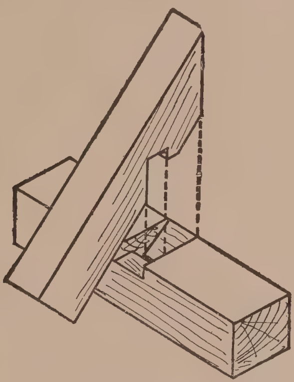


Fig. 38.—Notched Birdsmouth Join

binders. The depth having been marked with a gauge or template, and the width from the work itself, the rest is merely a matter of sawing and chiselling. Fig. 27 is also known as a cogged joint, and is used with extra heavy beams. Figs. 28 and 29 are end-notched joints, employed at the ends of joists, or when a cross rail is notched on to a wall plate or head piece in framed or stone buildings.

Fig. 30 shows the end of a roof joist or purlin notched into a beam or rafter in such a way as to withstand a tensile

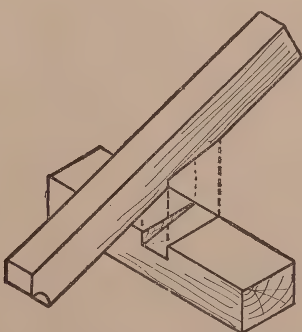


Fig. 39.—Bevelled and Notched Joint

pull. This is a good manner of binding a building. Fig. 31 illustrates another method of jointing to resist a pull by

driving a wedge into the joint. This may be considered as a cross half-lap, modified into a locking and wedged dovetail.

Figs. 32 to 39 show more kinds of notching, which can be used, graded from the simple to the rather complex,

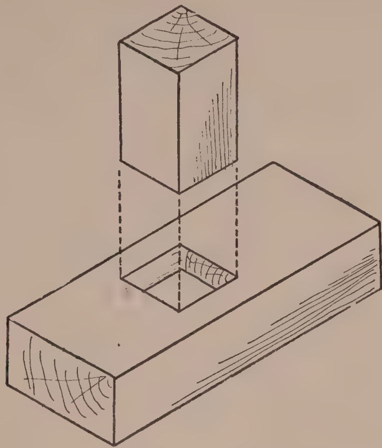


Fig. 40.—Plain Housing Joint

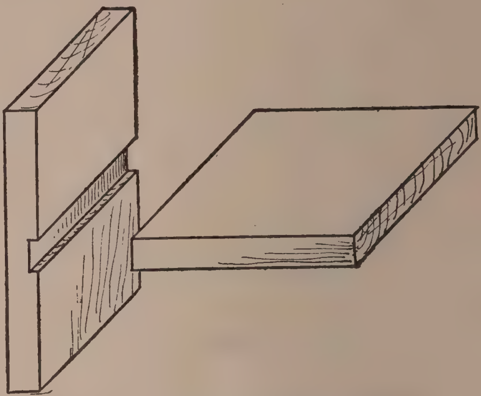


Fig. 42.—Full Housing for Shelf

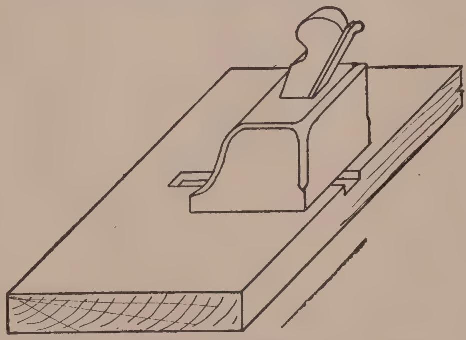


Fig. 43.—Clearing Housing with Router

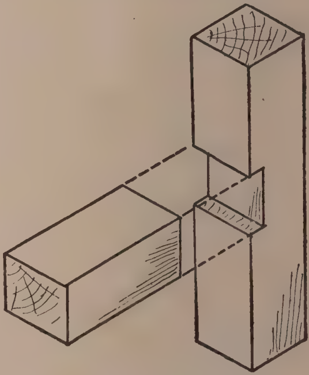


Fig. 41.—Full Housing Joint

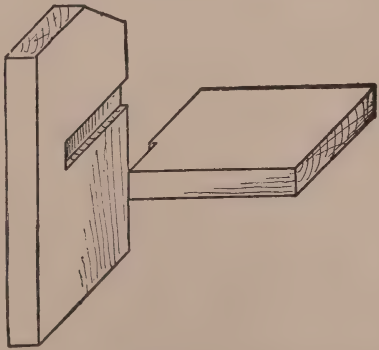


Fig. 44.—Stopped Housing Joint

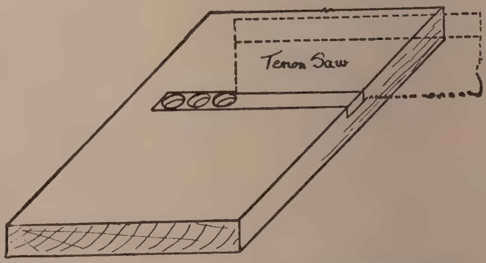


Fig. 45.—Method of Sawing Stopped Housing

to suit the greater or lesser importance of the work in hand. It is thought that the drawings are sufficiently explicit to render explanation needless, inasmuch as the joints are all derived from one or other of those already described. Some of them, it will be seen, may if desired be formed with the saw alone, but generally the chisel also is needed. The main thing necessary is to make sure of careful angling and accurate fitting.

Housed Joints.—Housing may be defined as sinking the end of one piece into a notch or groove cut in another for its reception. It is chiefly used for the ends of shelves, and for posts, rails, etc. Figs. 40 to 42, 44, and 46 to 52 illustrate different housing joints. Fig. 40 shows a post housed into a sill; though this

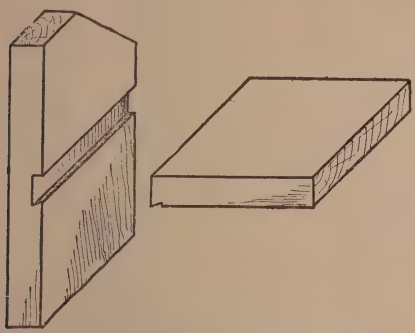


Fig. 46.—Dovetailed Housing Joint

ought only to be done when the top also is fixed, otherwise the depth is insufficient for rigidity. The recess may be set out from the bottom of the post itself, and is then chiselled away like a mortise, keeping well inside the marked lines to ensure a tight fit.

Fig. 41 is typical of the rail and post joint, as in the case of a door post and head for a hut framework or partition. It is fastened by nailing from the back.

Figs. 42, 44, and 46 to 48 show five methods of housing shelves into the upright ends of a bookcase or cabinet. In setting out, the parallel lines for the sinking should always be marked exactly to the thickness of the shelf. Then, for the plain housing (Fig. 42) having gauged to the depth, the lines are sawn down, with the saw kerfs inside the waste wood, to the gauge marks. The core or waste is next taken out nearly to the depth with a narrow chisel, and the trench is often finished with a router, or "old woman's

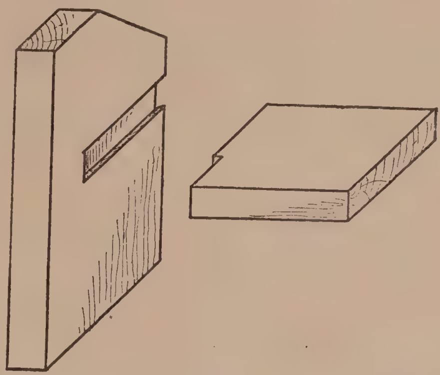


Fig. 47.—Dovetailed and Stopped Housing

tooth," to a flat bottom as shown by Fig. 43. The chisel in the router is adjustable to any desired depth. By the foregoing method the sinking is left visible on the front edge of the upright; it looks decidedly better if this is avoided

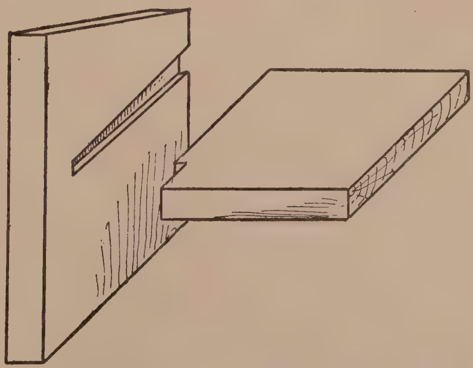


Fig. 48.—Tapered, Dovetailed and Stopped Joint

by "stopping," as seen in Fig. 44. The latter may be done by gauging the width of the stopped end, and using the saw slantwise on the marked parallel lines till the cut reaches the stop and is the right depth at the other end; the sinking

is then finished with a chisel. Another way is to get a start for the tenon saw by boring three or four holes with a centre bit to the width and depth of the groove, these holes being afterwards cut out square with the mallet and chisel. The saw can now be inserted and the groove finished off with the router (*see* Fig. 45).

A stronger joint, to resist an endways pull, is obtained by dovetailing or bevelling one edge of the housing, as seen in Figs. 46 and 47, the first being plain and the second stopped. The best method,

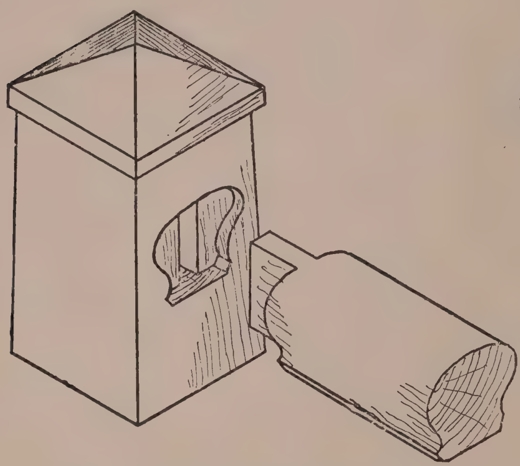


Fig. 49.—Housed and Tenoned Joint

however, as used for good furniture, is a stopped, dovetailed and tapered joint (*see* Fig. 48). When well fitted, glued, and driven in from the back this makes a perfect joint, both as regards strength and appearance. This joint requires no nailing.

A type of tenoned and housed joint used between a newel post and hand-rail is illustrated by Fig. 49. In a thick newel post, shrinkage is almost certain to occur, which causes the joint at the shoulder to open. This defect is prevented by housing the whole of the hand-rail into the post to a depth of about $\frac{3}{8}$ in., which permits the post to shrink or expand at will. To do this a mortise and tenon is first made. The tenon is inserted and the rail marked round with a marking awl, the housing for the rail being finally cut with mallet, chisel and scribing gouge.

The housed joint between the pulley

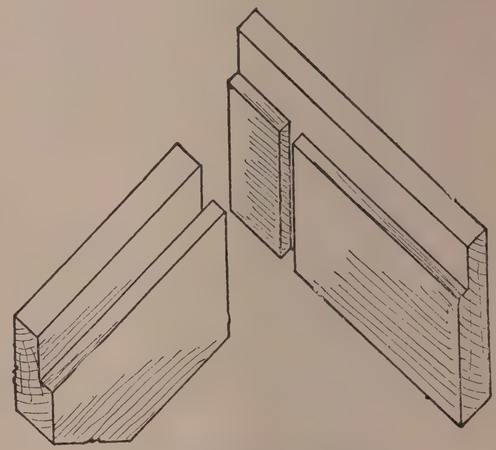


Fig. 51.—Trenched Joint

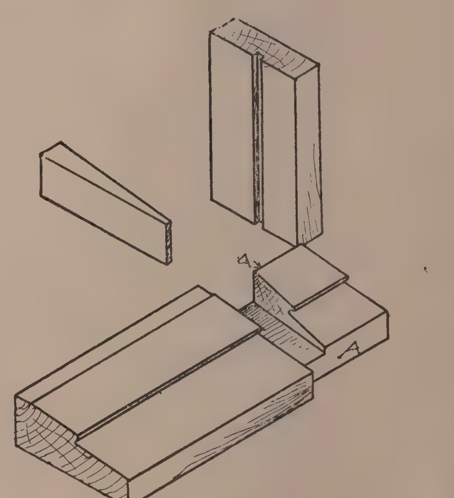


Fig. 50.—Wedged Housing Joint

stile and bevelled sill of a double-hung sliding-sash window frame is shown by Fig. 50. The housing is tapered, and is cut wider than the thickness of the stile, in order to allow the insertion of a wedge behind the latter, as indicated. The trenching is often set out, squared over, and cut before rebating and bevelling the sill, so that the try-square and gauge

may be used. The pieces notched at the sides marked A are cut out for the reception of the outside and inside linings, which form the box for the sash-weights to slide up and down in.

Fig. 51 shows the joint between the head and side of an ordinary inside door casing to be fixed in a brick or stone opening. This joint is fitted tightly and is nailed from the upper side of the head.

Fig. 52 illustrates the housed trenching of a stair string to receive the step ends. It will be noticed that the sides marked B are out of parallel in order to admit a glued wedge C besides the step end, to ensure a good fit on the top side of the tread and a rigid fixing.

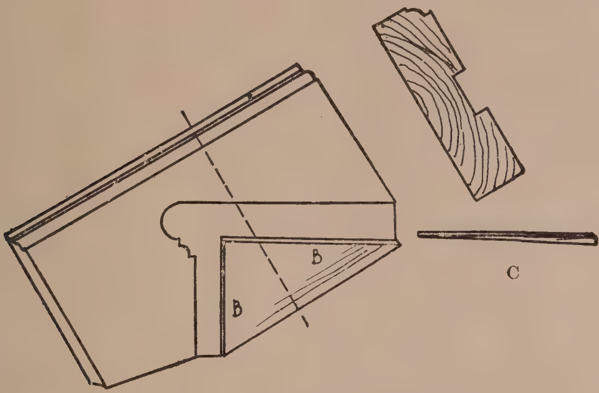


Fig. 52.—Trenched Housing for Stairs

Edge and Angle Joints

Glue Joints.—What are known as glue joints are those which depend chiefly, or, at any rate, to a large extent, on gluing for their adhesion and strength, though not necessarily to the exclusion of other factors. These comprise butt, slotted screw, tongued and grooved, feathered, and keyed joints. They are mostly used to join up boards to a greater width than can be obtained singly, and for angles.

Fig. 1.—Butt Joint Correctly Made

Fig. 2.—Butt Joint Badly Made

Glued Butt Joints.—This is the simplest form of glue joint, consisting of two (or more) boards planed straight and square on adjacent edges and glued together, as shown in section by Fig. 1. It is not nearly so easy as it looks. In making such a joint, especially when a fairly long one, the patience and skill of the novice, and sometimes of the professional, are taxed to the utmost, and it often happens that when the two boards fit closely together they are not straight on the face, appearing instead as in Fig. 2. The remedy, of course, is further careful planing.

Should the wood be over $\frac{3}{4}$ in. thick, the joints are best made with the boards fixed in the bench vice, the trying plane being held with the fingers of the left hand under the plane face, and the finger tips running along the face of the board so as to act as guides and keep the plane iron in the middle, either for the whole length of the board or for a portion only, as may be needed, and for good jointing aim should always be made for the final shaving to be the full length of the board. The feet should be placed to facilitate walking in the direction of the length.

The trying plane used for jointing should be in good condition. The cutting iron should be as thin as possible and only very slightly round on the edge, while the back iron should be set down to within the merest trifle of the cutting edge of the front iron. The shavings taken off will then be no thicker than the thinnest tissue paper. Rough, "near enough" work will not answer; indeed, the joints must fit exactly together, and this is achieved when no light can be seen through the joint. This is most important.

For thinner boards and very short joints there is no better way than the "underhand" method of using the plane. This necessitates the employment of a shooting board (*see* Fig. 3 and also the chapter on mitreing), a handy appliance which should be found in every workroom. The main portion A may be 9 in.

wide by 1 in. thick; it must be straight and out of twist. The part B on which the plane works should project about 3 in., and is screwed to the under side of A. The strip C, of the same thickness as B, is merely to make the board level. Fig. 4 is a sectional view, with the plane and work in position.

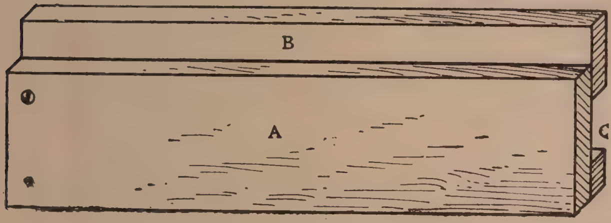


Fig. 3.—Shooting Board

One of the pieces to be jointed should be laid on the shooting board face upwards, while its fellow must be "shot" face downwards, to counteract the state of things indicated in Fig. 2, which might be caused by the curvature of the plane making the edges slightly out of square.

The edges of the boards should be tested with the try-square, and by holding the two surfaces in contact between the worker and the light. The parallelism of the boards when together should also be verified by laying a straightedge across.

The glue employed for the joints must be of the best quality and comparatively freshly made. It should be used as hot as possible.

A great many people undoubtedly make it too thick, under the impression that it will be stronger, whereas the exact reverse is the case. The glue should run off the brush like thin paint.

Undoubtedly the best way to put glue joints together is by "rubbing"; that is to say, the two edges are glued liberally, and then the two boards are rubbed to and fro in contact, as shown in Fig. 5, so as to rub as much of the surplus glue out of the joint as possible, and incidentally to rub it well into the pores of the wood. For joints of any length assistance is required, otherwise it is difficult to keep the boards flush at the sides and ends. As the to and fro movement becomes stiffer, proving that the glue is beginning to set, the boards are brought finally into correct adjustment, and should then be no more interfered with till set hard.

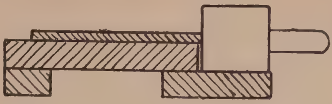


Fig. 4.—Section of Shooting Board in Use

When more than two boards are to be joined at one time (as in Fig. 1), the upper joint should be made first; then, while these two boards are held vertically, the under edge can be glued, as well as the upper edge of the next board, and the two already joined rubbed down on the single one. If the contrary order is adopted, the first joint is sure to be broken. It is, however, better to let one joint set before making another. A glued joint is sufficiently set for careful handling in two hours, and is practically at maximum strength in two days.

The correct numbering of the joints as they are fitted up is very important, so as to ensure that the tested surfaces are those that will be glued. The system shown in Fig. 6 cannot fail to give satisfaction. It consists of straight marks

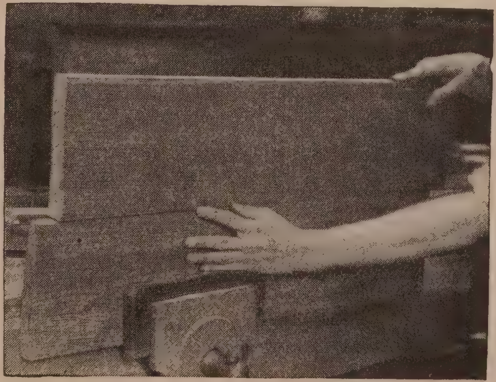


Fig. 5.—Rubbing a Glue Joint

and crosses made over each joint, so that each adjacent half is alike, but reversed. All numbering is best done before the jointing, and invariably on the best side of the wood.

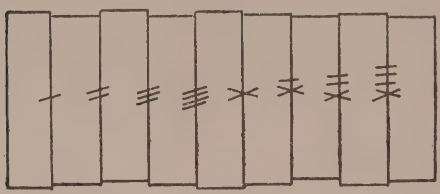


Fig. 6.—Correct Way of Numbering Joints

Steel dogs (Fig. 7) are very useful to strengthen the joints when set, especially in compound work. They cannot be depended on to pull the joints together, but are of much help towards holding them after rubbing so that they may be more freely handled. Fig. 8 shows the dog in use.

After making the joints the boards should be stood aside very carefully, so that the air can circulate freely between them. Fig. 9 illustrates a series of six joined boards, set away to dry with strips between. These strips must be parallel and should bed evenly on each board. They may be employed singly for short joints, but for anything over 3 ft. long it is best to have two strips between each board.

Slotted Screw Joint.—This is a butt joint having hidden screws driven into keyhole slots (*see* Fig. 10). It is used principally by cabinet-makers. The

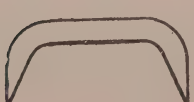


Fig. 7.—Steel Dog

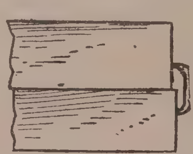


Fig. 8.—Method of Using Dog

screws are inserted at intervals along the edge of one of the boards to be jointed, leaving the heads projecting about $\frac{3}{8}$ in. Holes are bored in the edge of the other board so that the screw heads will fit into them, and slots are made leading from the holes, as shown, of the right size to take the shank of the screws. On placing the two boards together with the screw heads in the holes, and then forcing the top board to the right, the head of each screw will, as it were, dovetail itself into the wood and hold the joint together. When driving in the screws they must be made to lean slightly so that they will draw the joint together rather than apart; thus the left-hand screw in the illustration is wrongly inserted, the other being correct. It is also usual before finally gluing the joint, and after it has been tried up, to give the screws half a turn, thus ensuring a close joint.

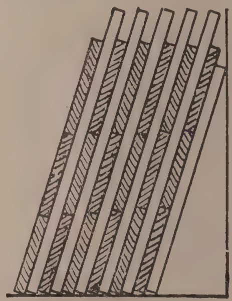


Fig. 9.—Stacking Boards after Gluing

Rebated Joint.—In this joint (Fig. 11) an open groove is cut at each edge to be joined, usually with a rebate plane. The edges require to be as carefully trued up as for the ordinary butt joint, and are glued in much the same way.

Tongued or Feathered Joints.—Either tongued or matched joints are now generally insisted on in preference to the glued butt. The first is illustrated in section by Fig. 12. A groove of equal width and depth has to be cut in both pieces with a "plough." This is a plane having a narrow iron, an adjustable fence to keep the groove at the right distance from the edge of the work, and usually also a device for regulating the depth.

To use the plough the fence is set by means of the two wedges to bring the iron in the middle of the wood (unless otherwise desired), while the gauge for the depth is adjusted by means of the

thumbscrew at top. The board is then fixed in the bench vice, and, holding the plough as shown in earlier pages, working is started to and fro on a portion at the

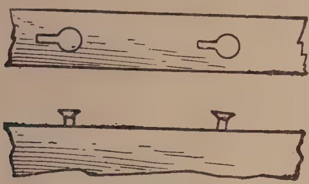


Fig. 10.—Details of Slotted Screw Joint

far end till almost deep enough. Next, stepping backwards, another short section is done, and so on, till the near end is reached. Lastly, one or two pushes are given along the entire length. Unless the grooves are made true, the effect of the finished joint will be as indicated exaggeratedly by Fig. 13, and the tongue will be of more trouble than use.

The tongues, or feathers, are thin planed-up wooden-strips, usually cut parallel with the grain, though some prefer them cut across. Opinion is divided as to which is best. If good three-ply wood is available it makes excellent tongues, combining the advantages of both the parallel and cross varieties, but to prevent the grain stripping the outside ply should be parallel with the wood to be glued up.

For a perfect joint it is requisite that the tongue should fit just closely in the

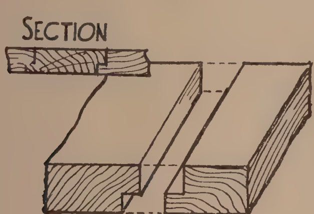


Fig. 11.—Rebated Joint

grooves without being tight, and be slightly less in width than the combined depth of the two grooves, so as not to bind when the joint is glued up. Such a joint is shown sectionally by Fig. 14, and it will generally prove more difficult to divide than the surrounding wood. To make tongued joints easy to rub when gluing, the tongues should be planed slightly uneven in thickness, so that one edge fits tightly while the other will be loose enough to allow the board to be rubbed to and fro. The tight edge is obviously inserted first.

To glue the tongue, lay it on the joint and rapidly cover one side with glue, then turn it over and do the other side, after which it should be tapped into its

Fig. 12.—Section of Tongued or Feathered Joint

Fig. 13.—Section Showing Result of Careless Ploughing

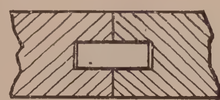


Fig. 14.—Section of Perfect Tongued Joint

Fig. 15.—Section of Double Tongued Joint

groove. Then the two edges of the board are glued with the projecting tongue and the joint rubbed quickly.

In very thick material it may be advisable to use double tongues, as shown sectionally in Fig. 15, which is preferable to using a single thick one. In that case, the two grooves should be ploughed from the same side of the wood, otherwise they will probably fail to coincide, and crippled tongues would result.

Rebated and Filleted Joint.—This may be regarded as an open-grooved

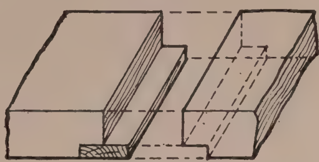


Fig. 16.—Rebated and Filleted Joint

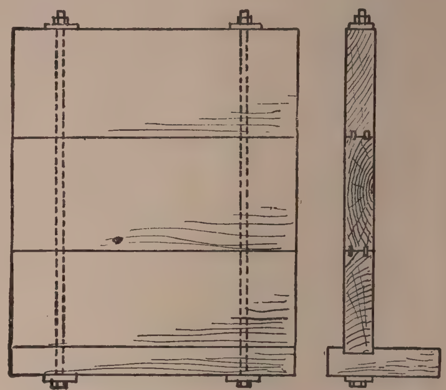


Fig. 20.—Jointing Boards for Cistern

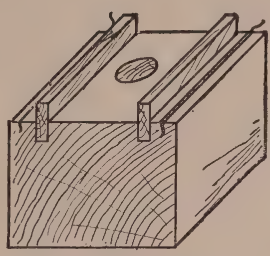


Fig. 21.—Tacking Tow String to Joints

Fig. 17.—Matched, or Tongued and Grooved Joint

tongued joint. It is suitable for work of which only one side shows, and which is not subjected to a bending strain. It is illustrated by Fig. 16.

Matched Joints.—This type of joint (Fig. 17) is also known as grooved and tongued; but, while the groove on one board is cut with a plough as before, the tongue is formed on the other board itself by means of a tonguing plane, which cuts a rebate on each edge, leaving a projecting piece between. The two are usually sold together as "matching planes" (*see* Figs. 18 and 19). The

Fig. 18.

Fig. 19.

Figs. 18 and 19.—Using Matching Planes

boards should be accurately shot and fitted before the matching is done, when, if the planes are in good condition, the joint will fit as well as it previously did.

Watertight Joints for Cistern.—Figs. 20, 21, and 22 show a method employed for constructing wooden cisterns, suitable for the water storage of a country house. The thickness of material may be from $1\frac{1}{2}$ in. to 4 in., according to the size of the tank. Red deal, elm, oak, and pitch pine are suitable woods to use for this kind of work. The planking should all be brought to the same thickness, the groove being ploughed from both faces with the same setting. This can only be done when the timbers have been machined to thickness.

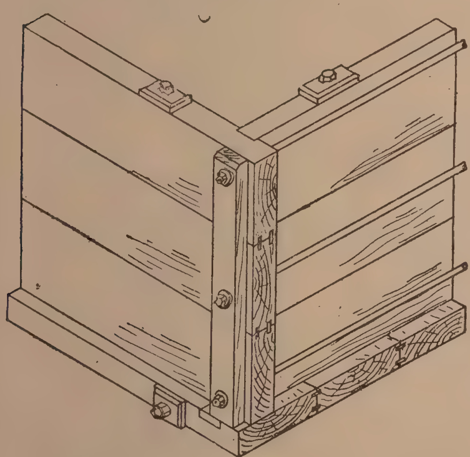


Fig. 22.—Bolting End of Cistern

Having made and fitted the joints, two lengths of tow string are tacked to them, as shown by Fig. 21, the whole being given two coats of priming paint before putting together.

In boring the holes for the long bolts it is better to bore from each edge to ensure true alignment. The end of the tank is put together in a similar way, being then fitted between and housed into the sides and bottom to an equal depth. Two or three lengths of tow should also be nailed on to the bottom of the grooves.

The end is kept in position by long bolts passing through the sides, and through stout pieces planted at the ends of the latter, as in Fig. 22, in order to

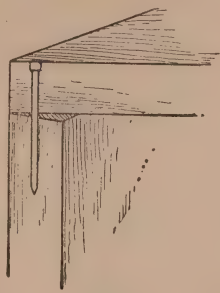


Fig. 23.

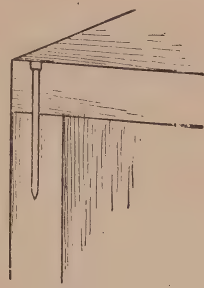


Fig 24.

distribute the pressure and keep the sides straight.

Angle Joints.—When nailing together end and side pieces, as for the angles of a box, care should be taken to select nails of the right length. For nailing into the end grain, the length should equal from $2\frac{1}{2}$ to 3 times the thickness of the first piece of wood. The distance apart should be at least equal to the thickness of nail, and it is better to slope the nails slightly towards each other; this is known as "lock nailing." Figs. 23 to 26 show the result of badly fitting nailed butt joints.

In cutting the ends of boards care

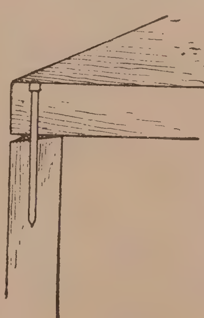


Fig. 25.

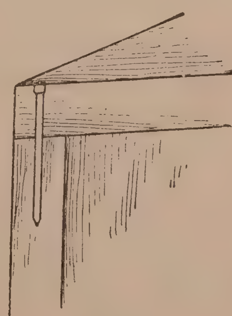


Fig. 26.

Figs. 23 to 26.—Examples of Badly Fitting Nailed Joints

should be taken that the tenon saw is kept at a right angle to the stuff. It is much better to shoot the ends on the shooting board, ascertaining at the same

time that opposite sides are of equal length, to ensure a true rectangle in the finished box.

When using this joint in furniture making it is better to nail and glue it; also, if the job permits, fixing glued

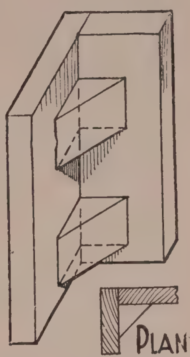


Fig. 27. — Butt Joint with Blocks

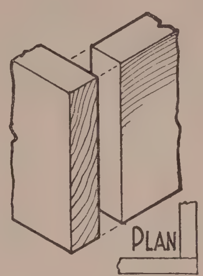


Fig. 28.— Simple Angle Butt Joint

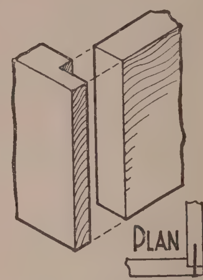


Fig. 29.—Angle Lap Joint

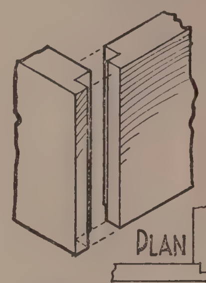


Fig. 30 —Double Angle Lap Joint

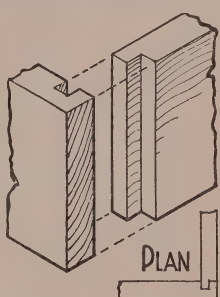


Fig. 31.—Square Grooved and Tongued Joint

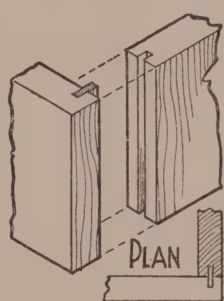


Fig. 32.—Square Tongued Butt Joint

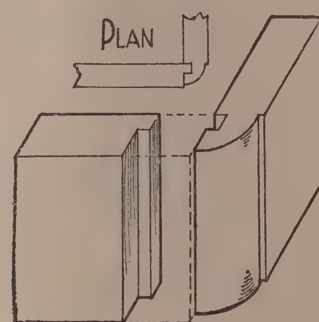


Fig. 35.—Tongued and Moulded Joint

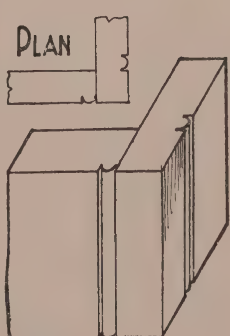


Fig. 33.—Beaded Butt Joint

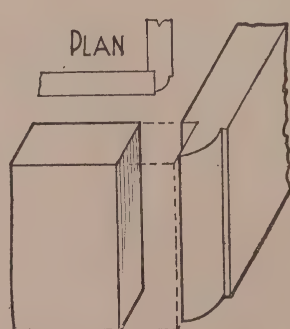


Fig. 34.—Rebated and Ovolo-moulded Joint

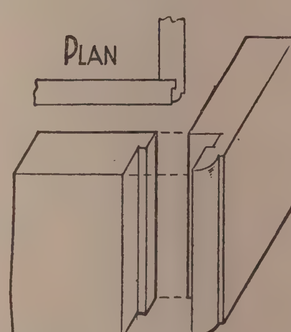


Fig. 36.—Rebated, Tongued and Moulded Joint

blocks into the internal angles, as in Fig. 27. Fig. 28 shows a simple angle butt joint ready for nailing or screwing. Fig. 29 illustrates the use of a rebate in one piece to receive the end of the other; this gives more surface for gluing and resists an inward pressure better, also it

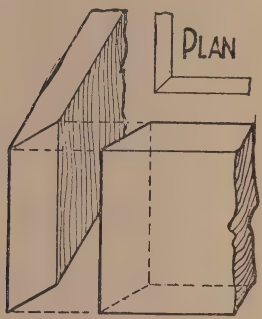


Fig. 37.—Plain Mitred Angle Joint

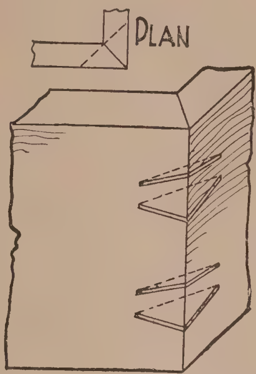


Fig. 38.—Keyed Mitreing

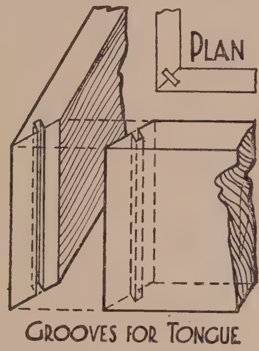


Fig. 39.—Tongued Mitreing

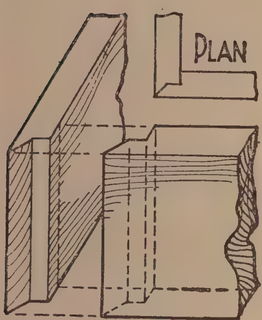


Fig. 40.—Rebated Mitreing

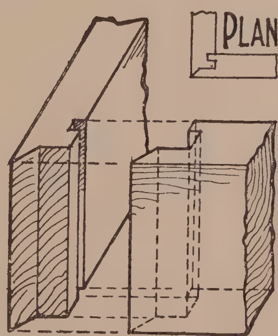


Fig. 41.—Grooved and Tongued Mitreing

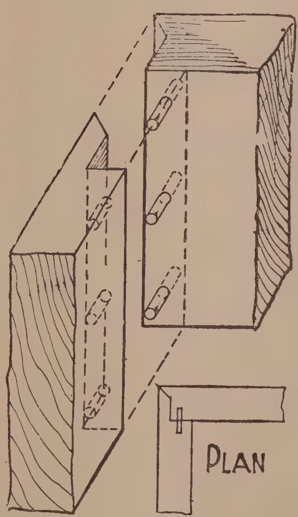


Fig. 42.—Rebated and Dowelled Mitre Joint

may be nailed in two directions if desired. A slight variation of the previous example, but a little stronger, is shown by Fig. 30.

The grooved and tongued angle joint seen in Fig. 31 is a very good form, but there is a danger of the short end-grain lap breaking off. It is, however, strong and serviceable when used as a side angle joint and glued. Fig. 32 illustrates an excellent joint, especially if a very thin hardwood cross tongue is employed.

Ornamental Angle Joints.—Sometimes, as for furniture, both butted and tongued joints are finished with a bead or moulding. Figs. 33 to 36 are typical examples. These joints are otherwise made in the same way as already described.

Mitred Angle Joints.—Figs. 37 to 39, and 40 to 42, show six methods of joining the ends of boards to form mitred angles. The plain mitreing (Fig. 37) and the keyed mitreing (Fig. 38) are used for skirting or plinth boards. Where extra strength is required with no details of the jointing showing, as in a plinth base for heavy furniture, such as

a wardrobe on which the carcase stands, the joints illustrated by Fig. 39 and Figs. 40 to 42 are employed. The appearance of the tongued mitre joint (Fig. 39) when finished is shown by Fig. 43. Fig. 44 indicates how the pieces are put together in the bench vice when grooving with the plough in order to have a face at 90° for the fence. By gluing triangular pieces to the face of each board a good seating may be provided so as to cramp up the joint effectively, as seen in Fig. 45.

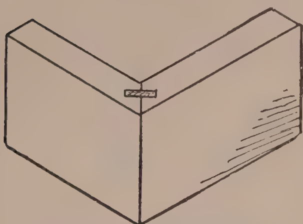


Fig. 43.—Tongued Mitre Joint, Finished

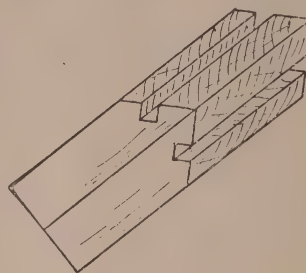


Fig. 44.—Position of Boards when Ploughing Tongued Mitres

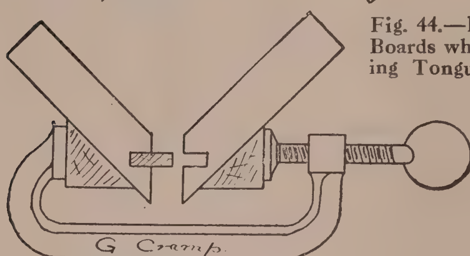


Fig. 45.—Method of Clamping Tongued Mitre

The rebated and dowelled joint shown in Fig. 42 is specially adapted for thick work, and gives particularly strong results. These joints can also be used for friezes, fascias, etc., on furniture and joinery fixings.

Obtuse Angle Joints.—Figs. 46 and 47 show two ways of dealing with a joint at an obtuse angle for either side or end grain. The rebating, grooving and moulding are discussed elsewhere, and need not here be explained. Fig. 48 illustrates a composite grooved and tongued angle joint, planed to a curve, as might be useful for skirting, a bottom stair, or a plinth to furniture.

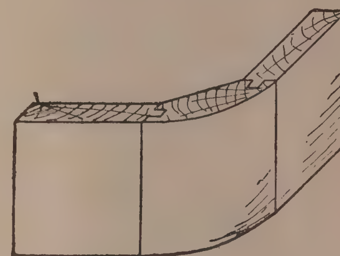


Fig. 48.—Curved Grooved and Tongued Joint

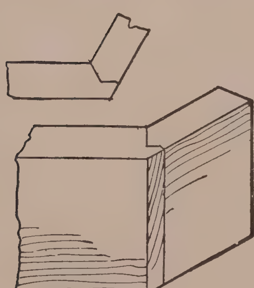


Fig. 46.

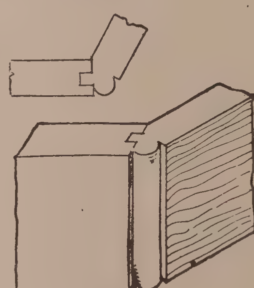


Fig. 47.

Figs. 46 and 47.—Obtuse Angle Joints: Rebated and Tongued

It must be borne in mind that the strength and rigidity of all this kind of jointing depends wholly upon a good tight fit and the best quality glue, properly applied.

Dowelled Joints

Uses of Dowelled Joints.—In a dowelled joint, holes are bored in line at a right angle with the two surfaces to be connected, and into these are inserted glued wooden pins. When properly done, the result is very strong and rigid, besides being quickly executed and effecting a saving of material; but if carelessly carried out it readily comes apart. In some cases dowels are used for parts intended to be removable, as in cornice

Fig. 1.—Wheelwright's Dowel

Fig. 2.—Ordinary Dowel

fitments, piano fronts, and extra leaves for dining tables. Another typical use of this joint is by the wheelwright, who inserts dowels into the ends of the curved wooden sections, or felloes, where they meet; not to hold the felloes to the wheel, but simply to keep them flush at the joints. The felloes are really held on the wheels by wedges inserted in the tenons formed on the ends of the spokes, and also by the iron tyres. The kind of dowel used for wheels is nearly spindle-shaped, as shown in Fig. 1. When, however, the dowels are required to hold the parts together entirely, by the aid of glue alone, they must be cylindrical, as in Fig. 2.

Making Dowels.—These should be of sound, well-seasoned, straight-grained material, preferably hardwood, and usually beech. A convenient method is to saw blocks two or three times the required length, and to split them into roughly rectangular sticks. The latter are then planed, first to a square section, next hexagonal, and finally circular. A handy

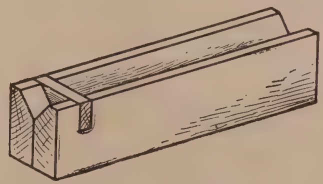


Fig 3.—Dowel Box

device to hold the sticks while planing is illustrated by Fig. 3. The dowels are then cut to length, and the square ends trimmed as seen in Fig. 2, to facilitate driving in. This is best done with a dowel-pointer used in the brace, but a knife or chisel can be employed. Some workers flatten one side of the dowels, or cut a narrow **V**-groove along them, to allow the escape of air and surplus glue, but others consider this unnecessary, and do not recommend it.

The dowels can be gauged to size and shaped up by passing them through a round hole in a piece of wrought-iron plate, letting the hole remain as left by

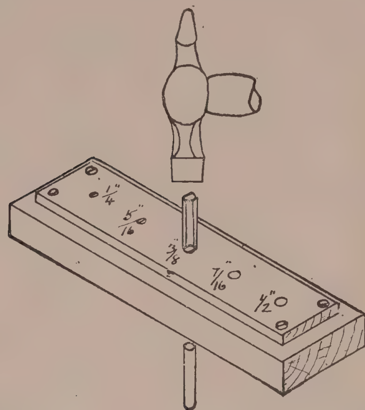


Fig. 4.—Dowel Plate, showing Method of Use

the drill. Fig. 4 shows such a dowel plate, mounted on a 1-in. thick hardwood block with various sizes of holes. The wooden base serves to keep the dowel vertical as it is driven through the iron plate. Dowels can also be turned in the lathe, or they may be purchased. They should not be too smooth; a slight roughness improves the strength of the joint.

Marking Boards for Dowelling.—For dowelling the edges of two boards together, first see that the surfaces meet

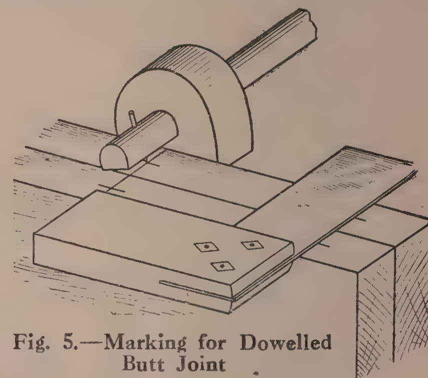


Fig. 5.—Marking for Dowelled Butt Joint

truly, as if for an ordinary glued butt; then fix them back to back in the bench vice. Mark the centre of each board lengthways with the gauge, from opposite sides, and measure off the positions for


Fig. 6.—Double-pointed Marking Pin

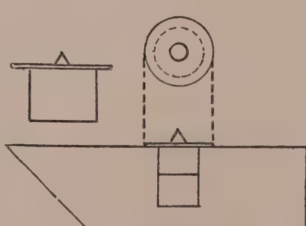


Fig. 7.—Dowel Pop, and Method of Insertion

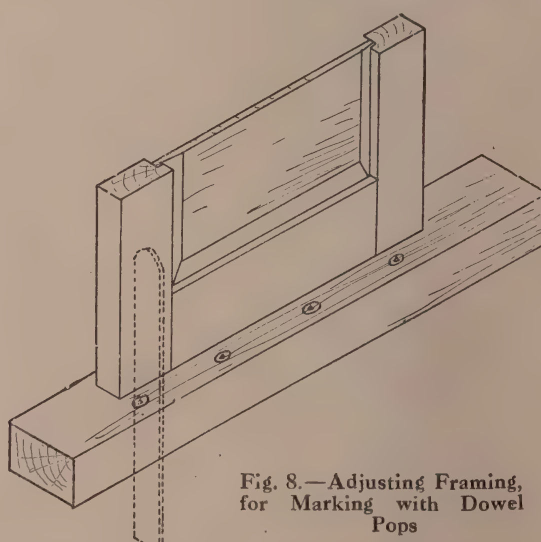


Fig. 8.—Adjusting Framing, for Marking with Dowel Pops

the dowels, from an inch or two to a foot distant, according to the work. Square these marks across the edges, and where the squared lines cut the gauged lines will be the points for boring. This method is illustrated by Fig. 5.

It is not always practicable to mark the two edges together, as, for instance, when a piece of woodwork is already partly made up. In such a case, some workmen use a kind of double drawing-pin (Fig. 6), having a point each side. One point is driven into the fixed portion where the dowel is to come, and the other piece to be joined is laid over the projecting point and tapped gently down. This obviously gives two marks exactly in line.

Dowel Pops.—Another good plan for marking the centres when boring dowel holes, used in Yorkshire, is to employ "dowel pops" (Fig. 7), of various sizes, usually cast in brass. Suppose it is the base of a wardrobe that requires dowelling. The holes are bored at suitable places in the base, away from shakes or knots, and the dowel pops are inserted, resting on their thin flanges. Next the framing is placed in position, resting on the projecting points of the pops, as shown in Fig. 8, measuring the equality of each side space and testing for flushness with a straightedge. A sharp tap is lastly given with a mallet on the top of the framing, when the points of the pops make impressions at the bottom of the latter, showing clearly where to bore for the dowels.

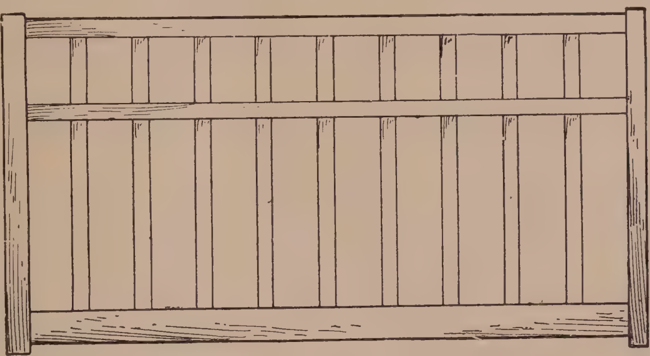


Fig. 9.—Length of Panelling to be Dowelled

Fig. 11.—Old Way of Setting Out Rail

Fig. 10.—Old Way of Setting Out Muntin for Dowelling

Marking Dowels for Panelled Work.—One method often adopted when making a length of panelling, such as is illustrated by Fig. 9, is to set out as for mortise and tenon joints (that is, by marking the width of one piece on the edge of the other), and then to measure and make fresh marks inside these at the proper distances for the dowels, squaring them across. A gauge mark is also made along the length of the wood to give the distance from the edge. The points where the inner lines cross the central line will then be the places to insert the point of the boring bit. This way involves a great deal of needless setting out, as will be recognised from Figs. 10 and 11, which show one of the muntins, or upright divisions between the panels, and a portion of the top rail set out in this manner. There is, too, some opportunity for error or mistake

A much better plan is to set out the timber as shown by Figs. 12 and 13, the first being the rails and the second the stiles and muntins. The marks indicated are all that are necessary, with the exception that the lines on the muntins (the middle pieces in Fig. 13) must be squared over as a guide to cutting off, while those on the middle rail will need squaring over on to the other edge of the wood. The muntins might, of course, be in two pieces, to obviate the waste of the two or three inches at the middle rail, as well as for convenience in converting. The setting out of the actual holes is done by means of a dowelling template,

made as illustrated in Figs. 14 and 15, the stock being of hardwood and the tongue of brass. The full length may be about 3 in., and the other parts in proportion. The tongue may be about $\frac{1}{8}$ in. thick, and the series of small holes

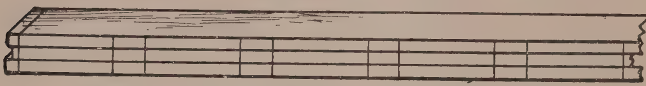


Fig. 12.—Better Method of Setting Out Rails

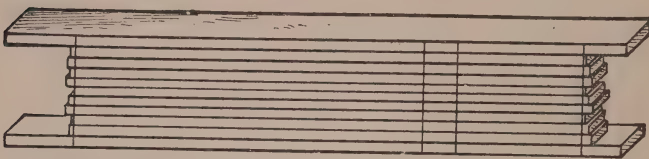


Fig. 13.—Better Method of Setting Out Stiles and Muntins

shown should be drilled truly, for on this will depend, in a great measure, the accuracy of the work set out with the tool. The tongue is screwed in the stock as shown in the section (Fig. 15), and both parts of the latter must be in the same plane, so that the tool can be used from either side, as occasion requires. In drilling the holes in the tongue it is also necessary to get them an equal distance from either end, and equally spaced, for the same reason.

The method of using the template is explained by Fig. 16. The tongue is placed level with one of the squared-over marks and the stock against the face side, when the dowel hole can be marked through a hole in the plate with a fine bradawl. The correct hole to use, in the present instance is that indicated by a cross at the left of the illustration. To finish the marking, slide the template to the right, as shown by the dotted lines, and mark through the corresponding hole at the other end. This is the manner of setting out for the muntins: that for the top or bottom rails is done as shown at the right, the two crossed holes being marked with the template in one position.

When setting out on, or for, wider rails, the template can be moved along, using the holes already marked as a guide, until the whole ground is covered; thus Fig. 17 shows a wide rail set out for six dowels, while Fig. 18 shows the end of a thicker rail, in the setting out of which two rows of holes in the template are used, alternately near the face and the back. This will be found much preferable to using stouter dowels.

When making panelling with dowelled joints, do not forget the grooves in which the panels will fit. The dowels should be kept well clear of these, as shown by the dotted lines in Fig. 19. It will, of course, be understood that the dowel holes must be bored before the grooves are made, otherwise there would be great difficulty in getting them correct.

Dowelling Chairs, Tables, etc.—For dowelling the legs of tables or chairs or the rails of a cabinet framing into the stiles, a template may be made from a piece of thin zinc, the exact size of the end to be joined. Three small holes are pierced in this, and it is then laid in position on the leg or stile and the holes

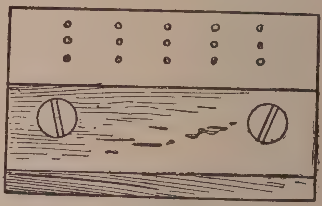


Fig. 14.—Plan of Metal Dowelling Template

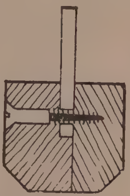


Fig. 15.—Section of Metal Dowelling Template

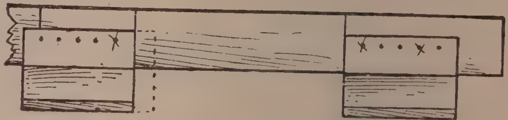


Fig. 16.—Method of Using Template for Setting Out

pricked through, as shown by Fig. 20. The other side of the template is used for marking the end of the rail. The holes

should be irregularly spaced, certainly not all in line.

Dowelling Doors.—To mark the centres for dowels in light doors, such

Fig.18.—Thick Rail Set Out by Template

Fig. 19.—How to Place Dowels in Grooved Work

Fig. 17.—Wide Rail Set Out by Template

as those of sideboards, cupboards in wash-stands, chiffoniers, etc., the wooden template illustrated by Fig. 21 will be found useful. It should be of hardwood and equal in length to the width of the door rail, the projecting part being as wide as the thickness of the rails and stiles. The holes should be the same distance from each end. In use, it simply needs to be held on the ends of the rails, which it fits, while marking the holes with the bradawl, being then transferred

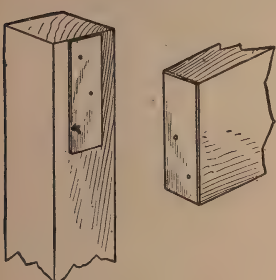


Fig. 20.—Setting Out for Dowels in Table or Chair

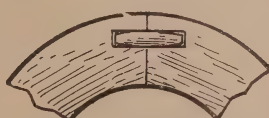


Fig. 25.—Felloes Correctly Dowelled

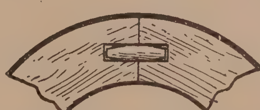


Fig. 24.—Felloes Joined, with Dowel Too Low

Fig. 26.—Section of Perfectly Dowelled Joint

Fig. 27.—Joint with Bent Dowel, through Faulty Boring

to the side edges of the stiles, to mark the corresponding holes near the top and bottom.

The bradawl employed for marking dowel holes should fit those in the template as nearly as possible, without being actually tight.

Dowelling Felloes on Wheels.—

Fig. 21.—Wooden Dowelling Template for Doors

Fig. 22.—Faulty Method of Marking Felloes for Dowels

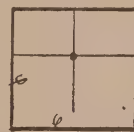


Fig. 23.—Correct Method of Marking Felloes

Fig. 22 shows the method often adopted to obtain the boring mark for dowels in wheel felloes, which may sometimes be useful for other circular work. With this it is necessary, however, for all the felloes to be true to size, a comparatively rare state of things. Therefore, a better way of getting the correct spot is that indicated in Fig. 23, where the face side and the inside of the felloe are gauged from, the crossing of the lines being the right spot for boring. The holes should be bored at a right angle to the end of

the felloe. It will be noticed that the mark is higher up in Fig. 23 than in Fig. 22. The former is correct, for if the

Fig. 28.—Diagram showing Various Faults in Dowels

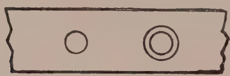


Fig. 29.—Plan showing Holes Before and After Opening

dowel is too low down there is a risk of splitting off the lower corner of the felloe, where the grain is cut across. Figs. 24 and 25 will make this clear.

Boring Holes for Dowels.—The bit for boring dowel holes should be in good working order. a short-length twist bit being best. The right size for most work is $\frac{5}{16}$ in., though the $\frac{1}{4}$-in. or $\frac{3}{8}$-in. size may occasionally be found convenient. The bit must be kept truly vertical to the surface, or the joint will be unsatisfactory. Till expertness is gained, a try-square applied to the drill will be of assistance as a test. Fig. 26 is a section of a perfectly dowelled joint, where the two holes are bored to exactly the right depth and parallel with the sides of the wood, so that the dowel exerts its full holding power without being crippled in any way. Fig. 27, on the other hand, shows the effect of one of the holes being bored slightly out of parallel; in such a case the joint has to be forced together and held until the glue has set. Even then the dowel is crippled and its holding power much diminished.

Besides being parallel with the sides of the wood, it is equally important that the holes should be truly at a right angle to the joint the other way. Fig. 28 shows a series of four holes bored for dowels, that on the extreme right being as it should be. The second is bored correctly in the lower part but badly in the upper; therefore the dowel will be more or less crippled in putting the joint together. In the third, the dowel will be quite straight when in place, but it will have to be bent to get it to enter, and will probably be injured in doing so; the fault here is that both holes are bored badly, though in such a way that one compensates the other. This kind of compensation is very undesirable, but sometimes cannot be avoided. In the last case, the extreme left, the holes partly miss each other, either through faulty setting out or extremely careless boring. When this occurs, the holes should be plugged up and re-bored, for if left as it is the dowel will prove worse than useless.

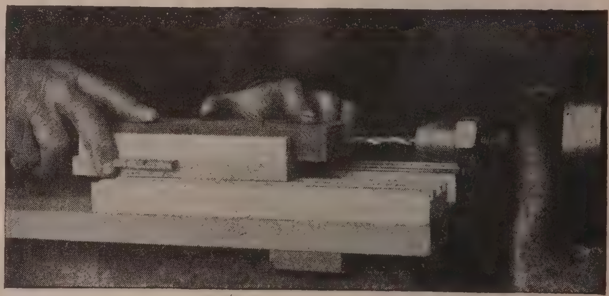


Fig. 31.—Method of Using Boring Fitment

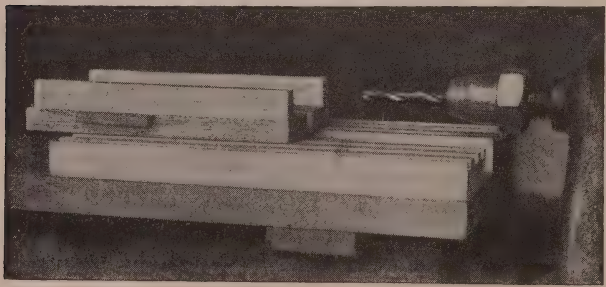


Fig. 30.—Fitment for Boring Dowel Holes in Lathe

The holes must be bored to a correct depth, a little over half the length of the dowel, to allow for glue and any trifling roughness at the bottom. Thus, with dowels $2\frac{1}{4}$ in. long, the holes should be $1\frac{1}{4}$ in. deep. With a good twist bit this may be gauged by counting the turns given, after testing the depth of the first hole. Another way is to place a wooden stop over the bit, or to use a metal bit gauge (*see* Chapter on Boring), to check it at the right distance down. A cylindrical piece of hardwood may be used, bored along the middle and furnished with a set screw to tighten it. It is as well to open or countersink the tops of the holes very slightly, as indicated by the second hole in Fig. 29, and seen sectionally in Fig. 26, this helps considerably in putting together and forms a sinking for surplus glue. The opening can be done with a snail or rose bit used in a brace.

Boring Dowel Holes in the Lathe.—If a lathe is available it forms an ideal appliance for making dowelled joints, obviating a great deal of the setting out, dispensing with a template, and, what is perhaps the best recommendation of all, boring the holes absolutely straight and true. The necessary fitment can readily be constructed to fit any lathe, and may be adapted to any thickness or width of material. The only parts which cannot very well be manipulated in the lathe are extra long pieces, owing to the room required; but in such cases the two methods are easily worked together, the long portions being bored in the ordinary way, as already described, and the shorter ones for the same job being drilled in the lathe.

The complete fitment is illustrated in Fig. 30, and the method of using it in Fig. 31; while Figs. 32 to 34 explain how it is made. Fig. 32 is a plan, and Fig. 33 a section, of the fitment in position on the lathe ready for work, the lettering being similar in each. The lathe bed is shown at A, while B is a clamp for bolting the fitment in place (two are required, one near the front and the other near the back). At C are cross-pieces, and to these the actual bed of the fitment, D, is screwed from underneath. On the top of the bed and level with the sides are fixed the two pieces E, provided with longitudinal and parallel grooves. In these grooved pieces slides the adjustable holder shown in Fig. 34. This latter consists of the two side pieces F, on the bottom of which are formed projections that will just fit into the grooves in E, these projections being nearer to one side than the other, as indicated. On the top of the pieces F are screwed strips G, level with the outside edges. To keep the two side portions of the holder in position, and yet allow them to be divided easily and quickly, so that they will fit into any of the grooves in E, a cross-bar H is sunk into the pieces F, so that it is level with their upper surfaces and passes under the strips G, thus retaining them rigid and parallel, and at the same time permitting a lateral adjustment.

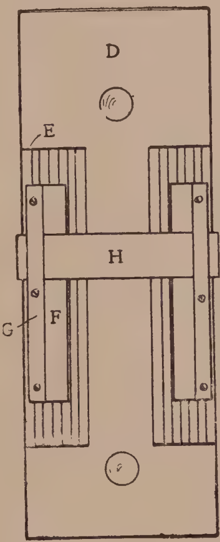


Fig. 32.—Plan of Boring Fitment

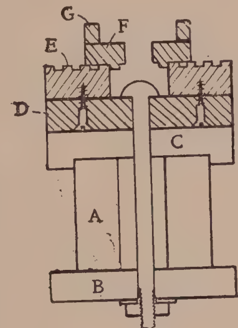


Fig. 33.—Section of Boring Fitment

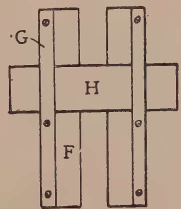


Fig. 34.—Holder, or Feeding Portion of Fitment

The fitment must be so fixed on the lathe that the centres are midway between the pieces F when the latter are in any pair of grooves. In the section (Fig. 33)

the guides are completely inside, that is as close together as possible; while in the plan (Fig. 32) they are in the middle groove.

The wood to be bored lies in the rebates formed by the pieces F and G, therefore the whole fitment must be built up according to the lathe, so as to bring the surface of F about $\frac{3}{8}$ in. below the actual lathe centre, when it will be right for working on any thickness of material from $\frac{3}{4}$ in. to $1\frac{1}{4}$ in.

To use the fitment the sliding piece should be placed in suitable grooves to bring the holes the correct distance from the edges, and then fed up to the drill, as in Fig. 31, working from each of the pieces G, and, if more than two holes are wanted, resetting after the first boring. The face side of the material must be downwards during the boring operations, and a guide mark should be made to act as a depth gauge. For boring rails or other horizontal parts, another sliding holder, similar to Fig. 34, is required, in which, however, the pieces G are shortened at the front, so that the wood to be bored can rest directly across F. The rails must be set out on the side opposite where the holes are to be. The marks are then placed to the inside of the shortened pieces G, and the fitment used as before.

The best tool for boring in the lathe is an ordinary twist drill. This will be found to act very quickly and easily; the sizes also will fit the stock dowels better than is the case with twist bits. The drill, of course, needs to be fixed in a chuck.

Gluing Dowels.—The parts being bored and ready to put together, the dowels cut off and trimmed, and the glue at hand (which should be slightly thinner than usual), the holes in one piece are glued inside, using a round stick instead of a brush. The dowels are also touched with glue at one end, and then driven gently home into the glued holes. The other part is now held against the first, as shown in Fig. 35, the two edges and the projecting halves of the dowels being rapidly brushed with glue, allowing a little to run into the holes. Lastly, the pieces are fitted promptly together with pressure, and cramped up tightly till set.

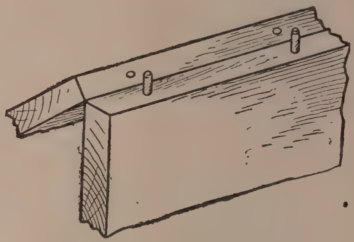


Fig. 35.—Parts of Dowel Joint in Position for Gluing

Some workers prefer "cold" or liquid glue for dowelling, since it does not set so quickly, but more time must elapse before the joints can be depended on to bear usage.

Mortise and Tenon Joints

The Mortise and Tenon Joint.—This joint, in one or other of its numerous forms, is the most important and probably the most used of all where strength and rigidity are required. It is of great value to carpenters, joiners, cabinet-makers, cart and coach builders, wheelwrights, shipwrights and aircraft workers. An advantage of this kind of joint is that it seldom needs reinforcing by metal fastenings.

The making of simple mortise and tenon joints in material of rectangular section will first be dealt with; then a number of examples will be given showing their application in different kinds of work, with hints for setting out and making.

Closed Mortise and Tenon.—One of the most common forms of this joint is the ordinary closed tenon, so called because the tenon is surrounded by wood on all four sides. Fig. 1 shows the setting out of the mortise, Fig. 2 the setting out of the tenon, Fig. 3 the mortise made, Fig. 4 the tenon cut, and Fig. 5 a section of the complete joint secured by a pin, though the latter is often omitted.

Using Mortise Gauge.—Save in exceptional cases, it is usual for the tenon to be one-third the thickness of the material, or thereabouts. While it is certainly possible to do the setting out merely by measurement, it saves much time and trouble to employ a mortise gauge (Fig. 6), for marking the two

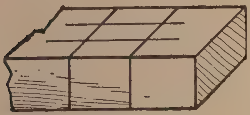


Fig. 1.—Closed Mortise Set Out

Fig. 3.—Closed Mortise Made

Fig. 5.—Section through Closed Mortise Joint, showing Pin

Fig. 2.—Tenon Set Out

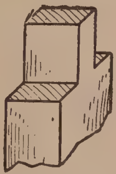


Fig. 4.—Tenon Cut

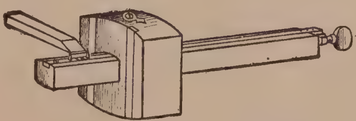


Fig. 6.—Setting Mortise Gauge

parallel lines on opposite faces of each piece, and on the end of the tenon portion. Except for large mortises, the width consists of single cuts with the chisel, hence the gauge requires setting to the

Fig. 7.—Beginning with Chisel on Bored Mortise

width of the latter by turning a nut at the end of the gauge stem, which regulates the distance between the two marking pins. The arrangement for setting the pins, however, varies in different patterns of gauges. The sliding stock is then moved till its face is the correct distance from the inner pin, and the screw tightened up. The lines indicating the length of the mortise and tenon respectively are measured and squared over on all four faces.

An ordinary marking gauge may, with a little care, be used to set out mortises and tenons by marking single lines from opposite sides, if the exact position for these is first measured centrally and the gauge set accordingly. This, however, presupposes that the wood is of uniform thickness and with truly parallel sides. It is better if only a marking gauge is available to set the gauge twice and work from one side only.

Cutting the Mortise.—The easiest way of making a mortise is to bore out part of the waste before using the chisel. A small piece of work may be held in the bench vice, while longer or very heavy pieces are best laid on two trestles. The back side should always be done first, and both sides should be bored from if the mortise goes right through the wood. It will be noticed in Fig. 7 that a third hole is bored. This is advisable in a longer mortise; in fact, as much of the wood as possible should be bored away, thus reducing the chisel work.

One often sees the method of mortising shown in Fig. 8 recommended, a small wedge-shaped piece being taken out in the middle and continued each way until the ends of the mortise are reached, when these are cut down square. This method is not a good one, as the chisel has to be reversed between each stroke, and it is impossible to remove so much of the waste wood as is desirable.

A better way is to commence nearly close up to the end of the mortise nearest the worker, cutting perpendicularly and as far in as the chisel will enter without using undue force. Then move the chisel back without reversing, and make another cut, removing the loose wood at the same time. Bring the chisel back to its first position, making another perpendicular cut, then take in a further piece towards the other end, and so on, till the whole length of the mortise has been done. The successive strokes are indicated in Fig. 9, and shown in plan by Fig. 10. By this

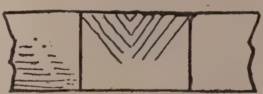


Fig. 8.—Incorrect Method of Chiselling

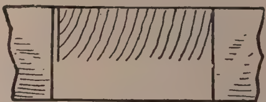


Fig. 9.—Correct Method of Chiselling

Fig. 10.—Plan of Correct Chiselling

method practically the whole of the wood is removed as it is cut away, while the work is done very quickly and cleanly.

Faults in Making Mortises.—Fig. 11 represents in section lengthways a series of mortises, of which N is the only perfect one. Here the ends are straight through from top to bottom—a result, unfortunately, but seldom found, even in

the best work. At O is seen the most usual product, in which the ends of the mortise are both cut under, as a rule purposely on the principle that the tenon

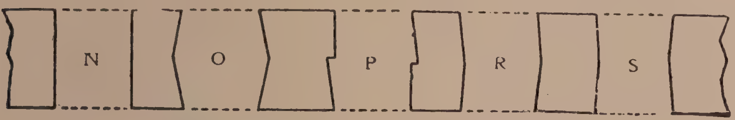


Fig. 11.—Faults in Mortising (Endways)

Fig. 12.—Faults in Mortising (Sideways)

will fit at each side and nothing else matters. That is true to a certain extent; but if the undercutting is overdone there is a risk of driving out the wood at the back when fitting together.

The faults shown at P and R are caused by carelessness or want of judgment, and the remedy is fairly obvious. The section shown in S is sometimes made intentionally, and is called a wheelwright's mortise. The idea is that the tenon being forced into the mortise causes the wood, as it were, to clinch itself, and needs no further fixing; but the notion is rather far-fetched, and such a joint cannot be very secure.

There is more excuse for making mortises of a bad shape at the ends than at the sides, but the latter also is by no means uncommon. In Fig. 12 are illustrated a series of sideways sections of finished mortises, of which T alone is satisfactory. The effect of U is that the holding pin cannot be so strong, owing to the tenon and the sides of the mortise not being in close contact; but in V the case is different, there being grave danger of splitting the work when puting the joint together. The slovenly cutting seen at W has very little influence on the completed joint; nevertheless, it should be avoided. In X the faults are glaringly apparent, and the wood will almost certainly split. The last two mortises are tapered, being wider at the top than at the bottom. In one case the right-hand side of the mortise has been made sloping and in the other both sides are inaccurately cut.

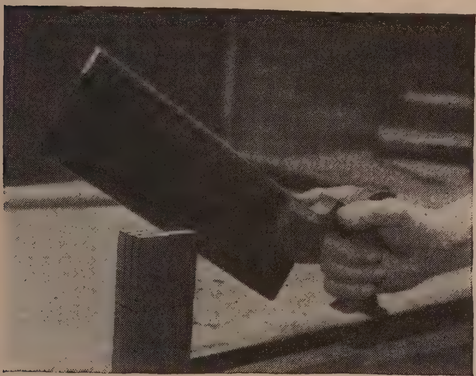


Fig. 13.—Starting Tenon

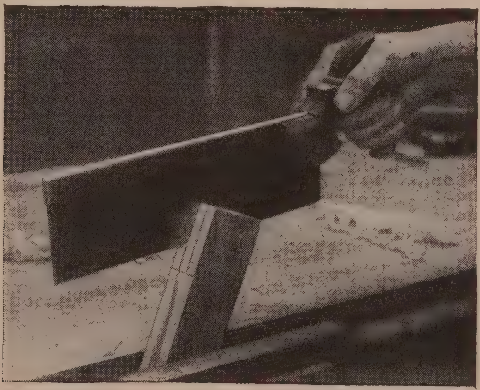


Fig. 14.—Making Tenon—after Reversing Wood

The last-mentioned batch of faults will only occur in the larger mortises The narrow ones, being cut to the width of the chisel, must come out the full width, but it is just possible to make the mistakes shown at V and W.

Sawing the Tenon.—Figs. 13 and 14 illustrate the commencement of sawing a tenon. The first shows the slight cut across the corner at the face side

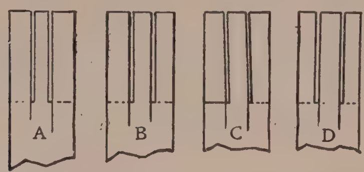


Fig. 15.—Various Faults in Sawing Tenons

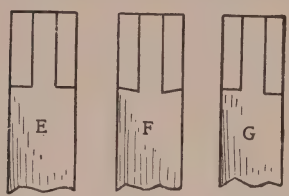


Fig. 16.—Various Faults in Cutting Tenon Shoulders

or edge, and the second indicates the position of the saw leading from this cut to the opposite side, after the timber has been reversed. This latter cut should gradually be run down on the side

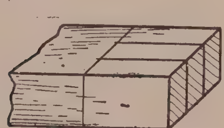


Fig. 17.—Slot Mortise Set Out

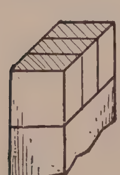


Fig. 18.—Setting Out Tenon for Slot Mortise

of the tenon nearest the operator, when the timber may be again reversed and the cut continued to the shoulder lines; or the cut may be finished at the second operation. The object of starting at the face side is to have the finishing cut there also. In the case of very long tenons the wood may have to be reversed four times instead of two,

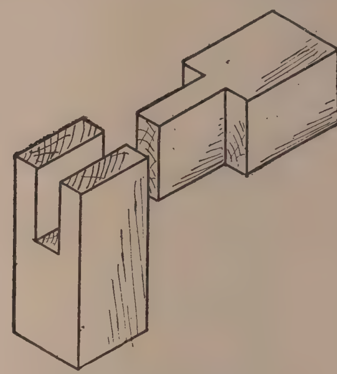


Fig. 19.—Finished Slot Mortise Joint, ready for Fixing

but it is better if the cuts begin and finish on the face side.

In making a shoulder cut the saw at first is held with its point down, the hand being then gradually lowered until the saw is horizontal, and the cutting proceeded with until it meets the tenon

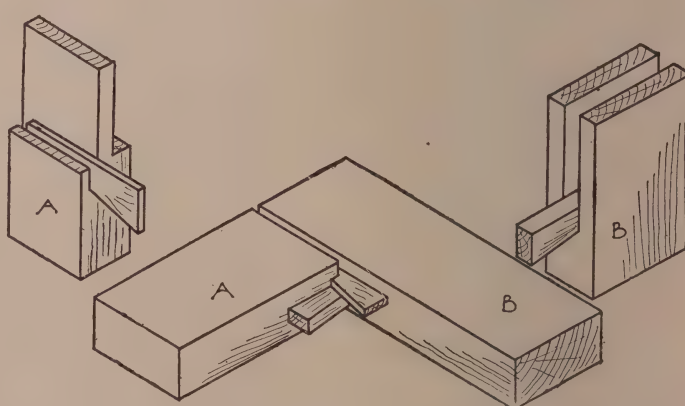


Fig. 20.—Adjustable Slot Mortise and Tenon Joint

cut, when the "cheek" will drop off. Unless it is a "barefaced" tenon, the other side is then done in the same way.

Faults in Sawing Tenons.—It is usually impressed on beginners that they

must learn to cut to the lines, and, of course, the advice is good; but it is quite possible to obey it literally and yet be far from correct, especially when sawing

Fig. 21.—Closed Haunched Mortise

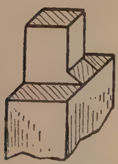


Fig. 23.—Tenon with Secret Haunching

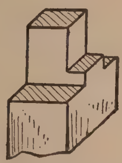


Fig. 22.—Haunched Tenon

tenons. In Fig. 15 are shown a series of tenons sawn in, but with the shoulders uncut; and of these only one is right, though all are sawn to the lines. Thus A is cut on the inside of the lines, which will make the tenon too thin; B is inside one line and outside the other, while C commences in the same way and crosses the lines. The correct method is seen at D, where the cuts are made on the outside of each line, leaving the tenon the full thickness to fit properly in the mortise.

Fig. 16 illustrates the right and the wrong way of cutting shoulders for tenons. Thus, E is correct; each shoulder is sawn in exactly to the mark, and will

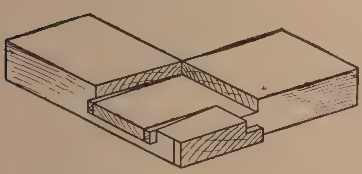


Fig. 24.—Cut-away View of Wedged Haunched Tenon

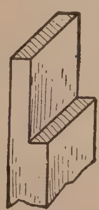


Fig. 25.—Barefaced Tenon Cut

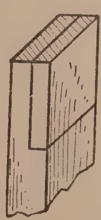


Fig. 26.—Setting Out Barefaced Tenon

Fig. 27.—Section of Barefaced Mortise and Tenon Joint

fit on the inside as well as on the outside. The shoulders at F are started at the lines but the cutting is continued "under," as the term is; in consequence they will fit on the outside only, and if any considerable amount of cleaning off is required the result will be an open shoulder. At G the cutting is worse still, one shoulder being sawn on the one side of the mark and the other on just the opposite, the effect being that only one shoulder will fit.

Slot Mortise and Tenon.—In this joint, also known as the "open" type, the mortise is merely a slot cut in the end of a piece of timber, so that the tenon can be driven in from the side. Fig. 17 shows the setting out of such a mortise, and Fig. 18 the setting out of the tenon, while Fig. 19 illustrates the finished joint ready for fixing together. It is often used in making door frames.

Adjustable Slot Mortise and Tenon.—Fig. 20 illustrates the familiar device employed to stretch the canvas for oil paintings. The shoulder is grooved out against the face of tenon with a $\frac{1}{8}$-in. chisel and sloped to fit a $\frac{1}{8}$-in. wedge, as shown at A on the left; while the slot mortise is made with a sloping end to receive a wedge full width, as at B on the right. The canvas is then tacked on to the frame and the wedges driven up till the required tension is obtained.

Haunched Mortise and Tenon.—In cases where the end of the mortised piece has to be cut off level with the tenoned piece, and a slot mortise is not suitable, the joint is "haunched," that is, the mortise is made shorter than the actual width of the tenon, as in Fig. 21, while the tenon itself is cut away, as in Fig. 22. The tenon is first sawn the

full width, as for the ordinary type, then the haunch is marked off and the small block of waste sawn away. The recess in the mortise to receive the haunch is sawn to the lines with the end of the tenon saw and finished with the chisel. Another form, known as secret haunching, is shown by Fig. 23; in this the haunch does not show on the end. Haunched joints are often secured by wedges at each side of the tenon, for which purpose the ends of the mortise are made a little

Fig. 28.—Door Frame, with Ordinary and Barefaced Tenons

wider and slanting outwards, as seen in the cut-away view (Fig. 24).

Barefaced Tenons.—A barefaced tenon has only one shoulder, the other side being flush with the face, as indicated by Fig. 25. Fig. 26 shows how the tenon is set out, the setting out for the mortise being readily understood from the section of the complete joint (Fig. 27). The barefaced tenon is used when one side of a rail has to be flush with the stile or post, while the other side is set back; as, for instance, when it is desired to fix matchboarding across the lower rails of a frame, such as is shown in Fig. 28. In that case the lower rails have barefaced tenons, while the top rail is the same thickness as the stiles, and has ordinary tenons. The barefaced joint is also useful when a stouter tenon is desirable than the thickness of the material would otherwise allow, as in the rails connecting table tops.

Stub or Joggle Tenon.—When a tenon does not pass right through the material it is known as a stub or joggle tenon. These are only employed to keep the tenoned piece laterally in position, and are seldom required. Fig. 29 is typical of such.

Oblique Mortises and Tenons.—These are more difficult and require careful setting out. Fig. 30 illustrates a rectangular frame in which two oblique braces are inserted. Fig. 31 shows the method of setting out the rails (note that the face marks are both on the inside); while Fig. 32 shows the top rail tenoned and haunched. The bottom rail (Fig. 33) does not require haunching. The stiles should be set out as a pair in the same way as the rails; one is shown in Fig. 34 with the mortises set out, including that for the brace, while Fig. 35 shows the cut mortises. In actual practice, however, only the mortises for the rails would at first be set out and made. The frame would then be knocked together, so that the braces can be laid on i in the position they will eventually occupy, when the mortises can readily be marked on the stiles and rails, as well as the shoulder lines on the braces, after which it is only necessary to square the various lines across to get the complete setting out.

Fig. 36 shows one brace after the various marks have been squared over and connected, and also gauged for cutting the tenons; while Fig. 37 shows the same brace after the tenons are cut. Before inserting the braces it is necessary to cut the tenons at the longest point to a right angle with the shoulders, and also to cut them parallel with the latter, thus bringing them to the shape seen in Fig. 38. The reason for cutting the oblique tenons

as described is to give them a much firmer abutment, and also to simplify making the mortises, as will be understood by reference to Fig. 39, where the method recommended is seen on the right, and the direct way on the left, both being in section.

In making oblique mortises it is a good plan to support the piece at a suitable angle in a box or cradle, or on an inclined plane, fixing a wedge-shaped block temporarily to the face of the work, so that the bit may be held vertically and enter at a right angle. This is illustrated by Fig. 40, where A is the stile to be mortised, B an inclined plane having a stop C, D a block secured to the stile, and E the bit. Or, in some cases, the stile and block might be clamped in the bench vice at the required angle, placing a piece of waste at the back of the hole to prevent splintering.

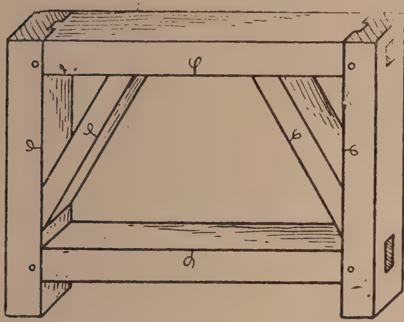


Fig. 30.—Framing with Oblique-tenoned Braces

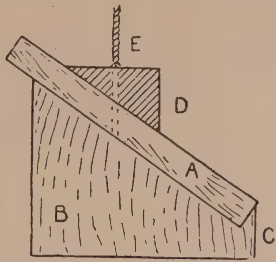


Fig. 40.—Arrangement for Boring for Oblique Mortise

Fig. 34.

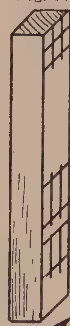
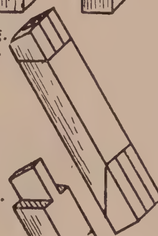


Fig. 35.

Fig. 36.



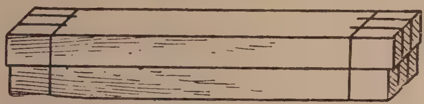


Fig. 31.—Setting Out Rails for Framing

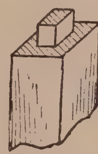


Fig. 29.—Stub Tenon

Fig. 37.

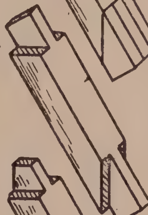


Fig. 32.—Top Rail with Tenons Cut and Haunched

Fig. 42.—Hook Tenon

Fig. 41.—Mortise for Hook Tenon

Fig. 38.

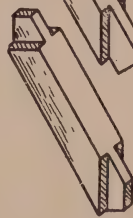


Fig. 33.—Bottom Rail with Tenons Cut

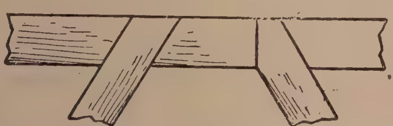


Fig. 39.—Section showing Correct and Incorrect Method of forming Oblique Tenons

Fig. 34.—Stile Set Out for Mortising
Fig. 35.—Stile Mortised
Fig. 36.—Oblique Brace Set Out for Tenons
Fig. 37.—Brace with Oblique Tenons Cut
Fig. 38.—Brace with Oblique Tenons Finished

Hook Tenon.—Figs. 41 and 42 show respectively the mortise and tenon forming a hook or dovetail joint. The mortise is made on the bevel at one end, or rather side, the tenon being cut to fit. Since the mortise obviously has to be the full width of the tenon, a space is left into which a pair of folding wedges can be inserted which hold the joint very firmly together, while, at the same time, it may easily be unshipped if desired.

It is often made long enough to project on the other side, and a hole is cut to receive a tapered key or peg.

Tusk tenons are also employed in general carpentry, especially in collapsible bookcases, garden frames, etc., in which case the tenon is often made thicker, and the hole for the peg or wedges cut through the face side of the wood, instead of through what may be called the flat or top of the tenon.

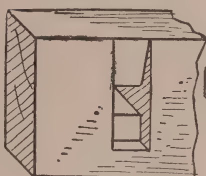


Fig. 43.—Mortise for Tusk Tenon

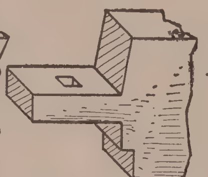


Fig. 44.—Tusk Tenon, with Hole for Peg

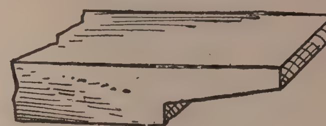


Fig. 45.—Barefaced Tapered Tenon

Fig. 46.—Section of Barefaced Tapered Tenon Joint

Fig. 47.—Section of Ordinary Tapered Tenon Joint

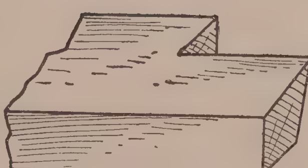


Fig. 48.—Unequal-sided Tenon

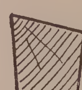


Fig. 49.—Section of Unequal-sided Tenon

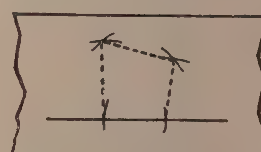


Fig. 50.—Setting Out Unequal-sided Mortise

Tusk Tenon.—Fig. 43 shows the mortise made ready to receive a "tusk" tenon, while Fig. 44 shows the tenon ready for insertion. This kind of joint is used in building construction for the framing of floor joists. It will be noticed that though the mortise is so small as to weaken the joist very little, yet the tenon takes a very strong bearing owing to the recess made below the mortise and the sloping cut above it. As a rule the setting out of this joint is done by placing the tenon in the middle as regards the depth of the joists and allowing it to be one-seventh of the depth only in thickness.

Tapered Tenons.—Some workers have a particular fancy for the tapered tenon; but while there are undoubtedly a few points in its favour for special purposes, it is not advised for frequent use. Great care must be taken in setting out to get the tenons accurate, for if too tight they will act as wedges and split the wood, while if too slack they depend entirely on the pin for security. In Fig. 45 is shown a barefaced tapered tenon, such as would be used for framing up the bottom of a wheelbarrow or farm cart, while Fig. 46 is a section of the joint finished. A similar tapered joint, but

with the ordinary double shoulders, is shown by Fig. 47. In all cases the upper side should be parallel with the face of the wood.

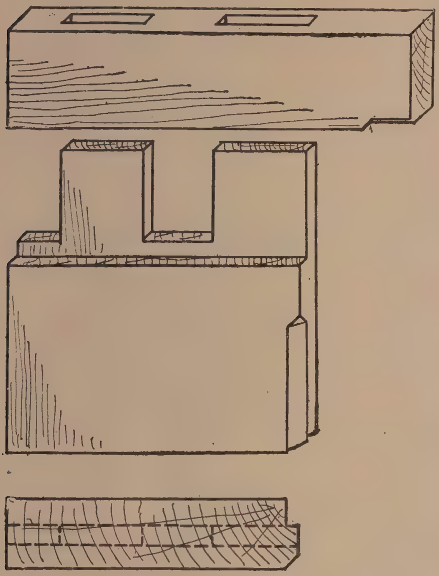


Fig. 51.—Double Tenon Joint for Bottom Rail of Door (shown on its side)

Unequal-sided. Tenons.—An unequal-sided barefaced tenon is shown by Fig. 48, and in section by Fig. 49. The mortise is set out as illustrated by Fig. 50, in which the straight line represents the face. On this is marked off the width of the tenon in the proper position, then, with a sharp pair of compasses, the width of the tenon is taken from back to front at each side and transferred to the wood, using the points already marked to work from, and striking arcs as shown. Next, the diagonals of the tenon are taken each way and transferred to the wood as before, lastly connecting the points where the arcs cut each other, as indicated by the dotted lines. A mortise made to these marks will be found to fit the tenon exactly.

Double Tenons.—In the case of wide timbers, such as the middle and bottom rails of panel doors, it is not desirable to run the tenons the whole width, which would not make either a strong or satisfactory job on account of the excessive shrinkage which would take place, leaving the tenons slack. Furthermore, the stile is weakened by having such a wide mortise. To overcome these disadvantages double tenons are used. Fig. 51 shows the double-tenoned joint between the stile and bottom rail of a 2-in. house door. Fig. 52 shows the setting out for the tenons, and also for the muntin mortise in the middle. It is a good rule to limit the width of the tenon to six times its thickness. The haunch at the bottom edge is to allow of enough end grain wood being left in the stile to wedge against. The small tongue forming the lower haunch, and the one between the tenons, are to keep the rail from warping, and also prevent light coming through the door should the joint open a little. It is a merit of double tenons that four wedges may be used, instead of only two.

Fig. 52.—Setting Out Double Tenons

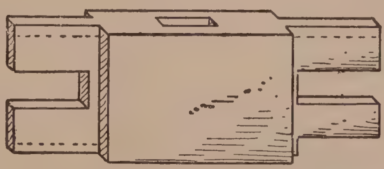


Fig. 53.—Double Tenon for Middle Rail (on Left)

Fig. 54.—Compound Double Tenon for Mortise Lock

The middle rail of a door should be haunched in the centre alone, as seen on the left in Fig. 53; the two haunches

required for the lower rail being shown on the right for comparison. The dotted lines indicate where the grooves for the panels will come, and, in actual practice,

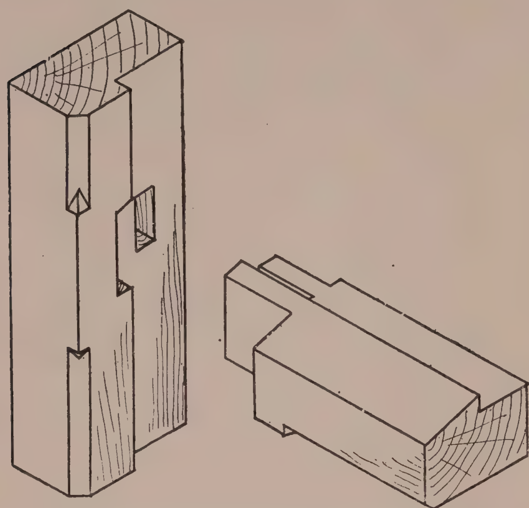


Fig. 55.—Double-tenoned Joint for Transom Rail

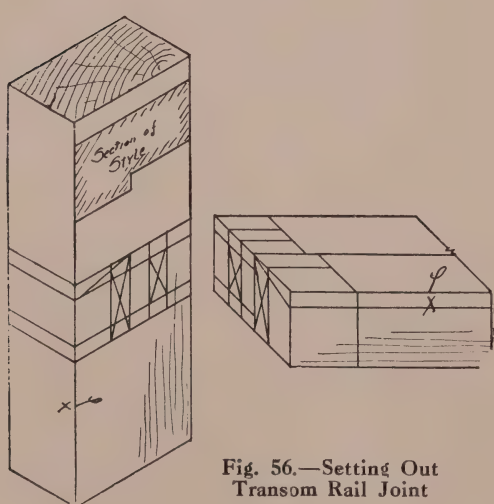


Fig. 56.—Setting Out Transom Rail Joint

these should be made before the shoulders are cut.

Fig. 54 illustrates another form of double tenon, set out on the right and made on the left, as used in the middle rails only of doors to be fitted with mortise locks. When it is known which way the doors will hang, these tenons would be made on the lock side alone;

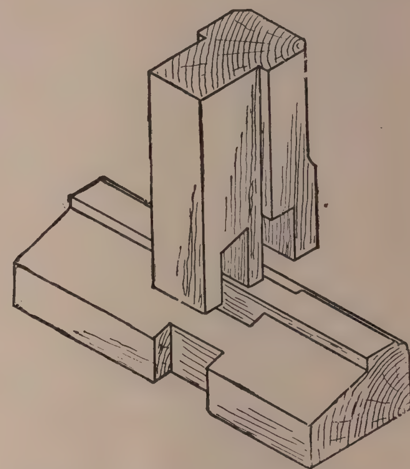


Fig. 57.—Tenoned and Bridled Joint

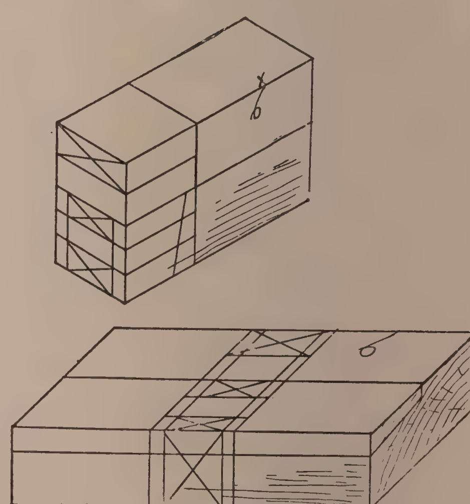


Fig. 58.—Setting Out Tenoned and Bridled Joint

but in the absence of definite information it is best to prepare both sides, as shown. It is also advisable to cut the mortise for the lock in the rail itself before putting the door together.

Fig. 55 shows the joint between transom rail and stile of an outside cottage door frame, rebated, weathered and chamfered, where, on account of the great thickness, a different kind of double tenon is called for. It will be noted that the tenons are not the same length, and that the near one is bevelled on its top edge to correspond with the weathered slope of the transom rail. When setting out for rebated and grooved framing, it is well to let the tenons coincide with the grooves and with the edge of the rebate. In this case the near tenon finishes level with the rebate. Fig. 56 illustrates how to set out shoulder and gauge lines in the square stuff, for all tenons and mortises should be cut before rebating, chamfering or moulding is begun.

Fig. 62.—Tenoned Joint for Segmental Rail

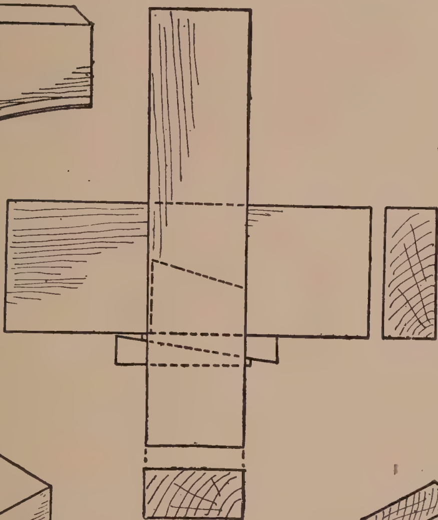


Fig. 59.—Locked Tenons

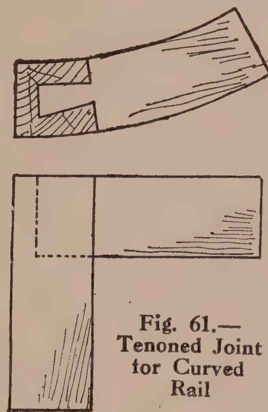


Fig. 61.—Tenoned Joint for Curved Rail

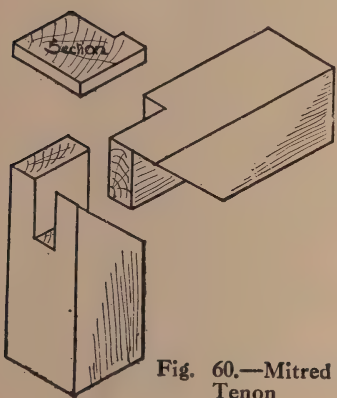


Fig. 60.—Mitred Tenon

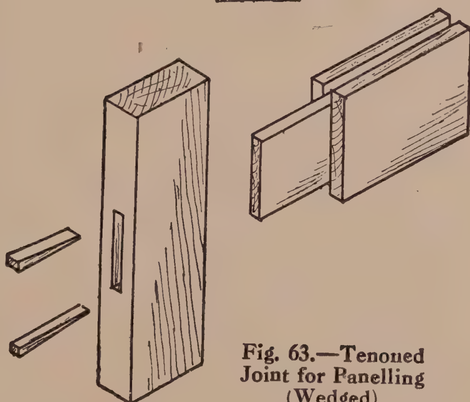


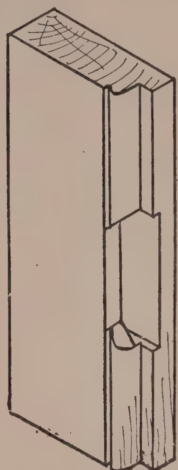
Fig. 63.—Tenoned Joint for Panelling (Wedged)

A somewhat related type of joint, though not a double tenon, is seen in Fig. 57. This shows a post tenoned and bridled into the sill, as in the case of a French window. When finished, the shoulder lines are, of course, vertical. Fig. 58 indicates how this joint is set out on the square. Wedges can be inserted from the bottom side of the sill into the middle tenon, and it is advisable that an oak pin should be driven through the whole joint from front to back. Previous to wedging up, the joint should be well coated with thick paint.

Locking Tenons.—Fig. 59 shows the method of tenoning when the rails are continued through a post in such a manner that the latter is continued in one piece from top to bottom. An example of this kind can be seen in the door-post and transom rail of a vestibule, and

sometimes in a large casement window. The tenons are made first in the usual way, being then cut and bevelled to fit each other, as indicated by the dotted lines, thus forming a locked joint. The mortise is cut wider than the rail, in rail, being then rested on the end of the stile, flush to the face, and marked round with an awl. The stile can now be gauged and the mortise slotted with tenon saw and chisel.

Fig. 62 shows how the segmental top



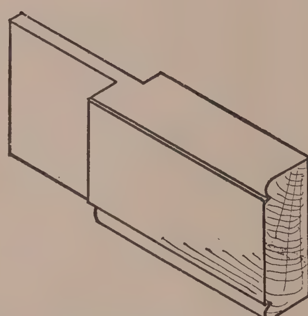


Fig. 64.—Tenoned Joint for Rebated and Beaded Work

Fig. 65.—Section of Joint for Deep Rebate

Fig. 66.—Section of Joint for Shallow Rebate

Fig. 67.—Shoulder Mitred for Bead on Face

Fig. 68.—Shoulder Scribed to Fit Moulding

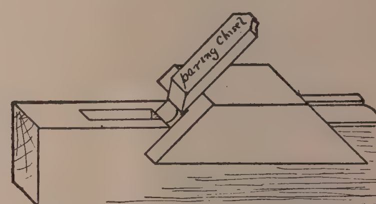


Fig. 69.—Method of Making Mitre

Fig. 70.—Mitre Template

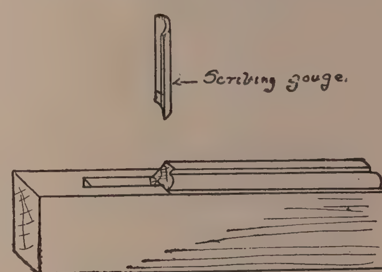


Fig. 71.—Scribing Moulding of Joint

order to let the bevelled tenons pass each other into position, and the extra space is filled up with a pair of folding wedges glued before insertion.

Mitred Tenon.—A mitred tenon may sometimes be needed in picture and other frames. A typical instance is shown by Fig. 60, the section displaying the rebate for the glass and picture.

Tenons for Curved Work.—Fig. 61 illustrates the joint for a door or window rail, curved in plan with the stile. The dovetail tenon is first cut on the curved rail of a glazed panel door is jointed to the stile. The bevelled shoulder will be noted from the full width of the stile at the top to the depth of the quirk in the moulding, which has been struck on the solid material. The shoulder lines should be marked on the square stuff, and the tenon cut before the curved cut is made and rebated to receive the glass. It will be seen that the tenon is haunched.

Tenons for Grooved, Beaded, or Moulded Work.—Fig. 63 shows the joint between rail and stile in ordinary

Fig. 72.—Mortises for Table-leg Joint

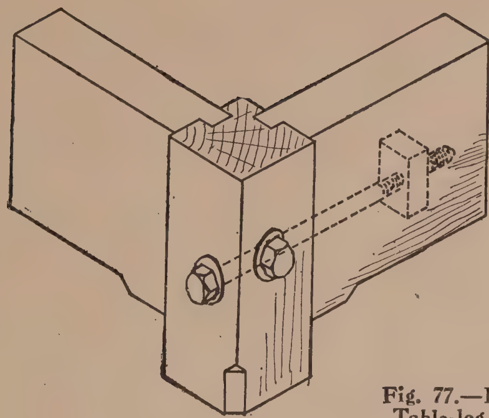


Fig. 77.—Bolted Table-leg Joint

Fig. 73.—Haunched Mortises in Table Leg

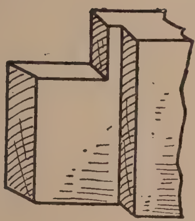


Fig. 74.—Rail with Haunched and Mitred Tenon

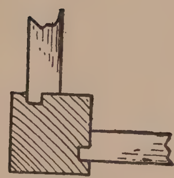


Fig. 75.—Top View of Table-leg Joint

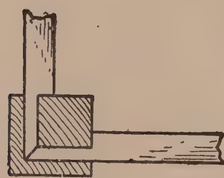


Fig. 76.—Section of Table-leg Joint

panelled framing, as in a door or dado frame. It will be noted that the tenon is narrower by the depth of both the top and bottom grooves in the rail made to receive the panels.

Fig. 64 shows the middle rail tenoned into the rebated and once-beaded stile of a cupboard frame. This kind of joint requires tenon shoulders of unequal length. The following general principles will make the procedure to be followed in such cases clear. Thus, when there is only a rebate to be considered the shoulders are cut to fit into the rebate, and the tenon so cut as to bring one side level with the latter. Fig. 65, for instance, illustrates the joint in section for a deep rebate, and Fig. 66 that for a shallower one. When there is a moulding on the side opposite the rebate, both shoulders have to be longer, so that one fits to the rebate while the other is mitred or scribed to fit

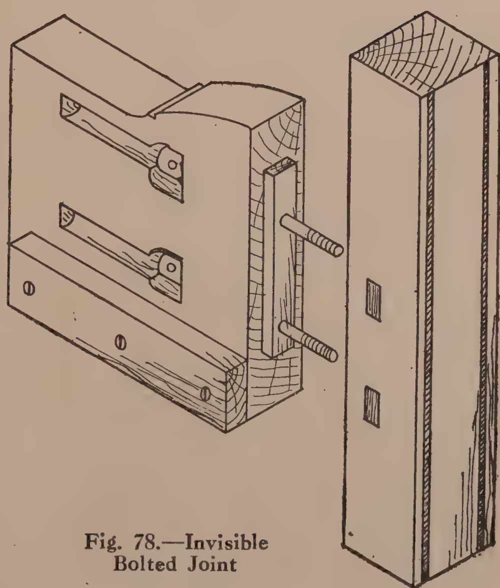


Fig. 78.—Invisible Bolted Joint

the moulding. Fig. 67 shows a shoulder mitred to fit a corresponding bead on the mortised head, and Fig. 68 shows the scribed joint to fit to a moulded head. Returning to the joint illustrated in Fig. 64, the method of mitreing is indicated by Fig. 69. This is done with a paring chisel, guided by a template (Fig. 70) cut to an angle of 45°. The method of using this mitre template is shown in Fig. 47, page 36. Fig. 71 shows the scribed portion being shaped with a scribing gouge.

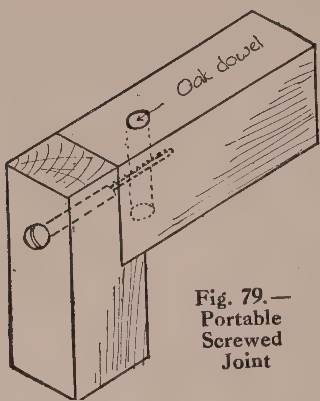


Fig. 79.—Portable Screwed Joint

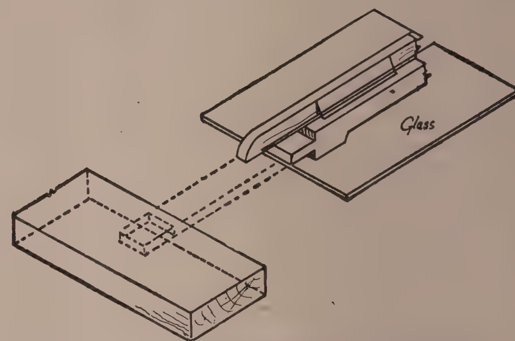


Fig. 80.—Top-light Mortise and Tenon Joint

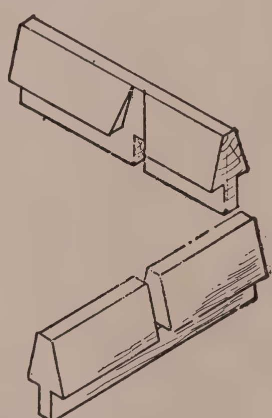


Fig. 82.—Sash-bar Joint: Cross Half-lap or Halved Joint

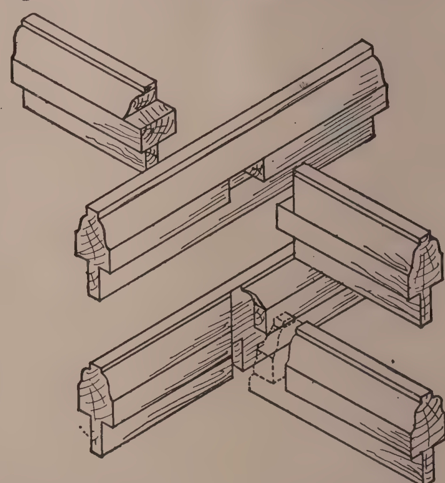


Fig. 81.—Sash-bar Joint: Upper, Mortised and Tenoned; Lower, Halved Joint

Table-leg Joints.—A table leg or corner post mortised to take side rails in two directions at right angles is shown by Fig. 72. Barefaced tenons are used, and the mortises continued till they meet. Fig. 73 shows the leg with the haunchings cut, while Fig. 74 illustrates one of the rails tenoned and haunched, the end being mitred to get the advantage of as much length as possible. Fig. 75 is a top view of the finished joint, and Fig. 76 a section showing the mitred ends of the tenons, which should be kept just short enough not to touch each other.

Bolted Table-leg Joints.—Fig. 77 shows a bolted barefaced tenon joint,

suitable to connect the rails and leg of a strong table or work-bench. This method is often employed in portable buildings to allow of the structure being taken down and stored away in pieces. The wooden framework of machinery is also mostly put together in this fashion, and many examples may be met with when visiting a flour-mill or an up-to-date dairy. The hole for the bolt is made after the tenoned rail is inserted into the mortise, and the nut is then sunk into the back of the rail. Great care should be exercised in fixing the nut true and firm, so that it will not shift when the bolt is withdrawn.

Another type of joint, with bolts arranged not to show from the outside, is illustrated by Fig. 78. The bolts have cylindrical heads with holes drilled through. This enables a nail punch to be inserted and the bolt screwed into the nut, which is sunk into the post and plugged up with the same kind of wood, selected to follow the graining. This joint is often met with in wooden bedsteads. The tenon is only needed to take the dead weight off the bolts, the latter themselves sufficing to hold the joint tight.

Portable Screwed Joint.—Fig. 79 shows a portable joint, just notched or stub-tenoned together, and held in position with a long round-headed screw. A hardwood dowel is glued and driven through the rail to receive the thread of the screw, which acts like the nut on a bolt. This joint is suitable for light framework, such as a meat-safe or dog kennel.

Sash-bar Tenon Joints.—Sash-bars require special treatment. Fig. 80 illustrates the joint between a rebated and chamfered sash-bar and the bottom rail of a skylight. It will be seen that the portion above the glass is continued over the bottom rail.

When making a long skylight, such as the glass covers for garden frames, it is better to let the tenon go right through the top and bottom rails and to wedge them up in the ordinary way, long tenon and short tenon alternately.

Figs. 81 and 82 give two methods of jointing moulded and rusticated sash-bars. The first is mortised and tenoned together, and is mostly used with thick bars, which are here shown scribed. The second is really a variation of the half-lap joint, with moulded and sloping sides cut to fit.

Fox-wedged Mortise and Tenon Joints.—In certain work it is not expedient for the tenons to go through the wood for wedging, and equally impossible to use pins. In such cases, carpenters and joiners generally adopt the method

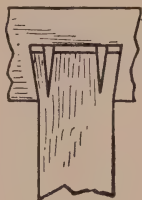


Fig. 85.—Section of Correctly Made Fox-wedged Tenon Joint

Fig. 83.—Section of Mortise for Fox-wedged Tenon

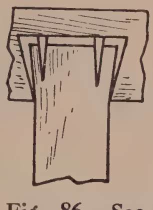


Fig. 86.—Section of Badly Made Fox-wedged Tenon

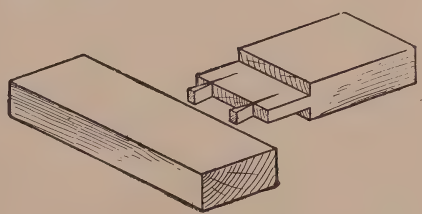


Fig. 84.—Fox-wedged Tenon Ready For Driving In

known as "fox" or secret wedging. This consists of making the mortise wider on the inside than the outside, by the thickness of the two wedges, as shown sectionally in Fig. 83. The rectangular tenon is made a little shorter than the depth of the mortise and saw kerfs are cut in the end; then the parts are glued, the wedges inserted, as in Fig. 84, and on knocking the tenon in the wedges are forced home by coming against the inside of the mortise. In consequence, the tenon is expanded into what is practically a dovetail, as illustrated by Fig. 85.

Fox-wedged joints are more or less successful according to whether the wedges and the sloping sides of the mortise are correctly made, and it often turns out that they are not. One common cause of failure is shown sectionally by Fig. 86, where the wedges are not large enough to expand the tenon to the full extent of the mortise, with resulting looseness. When, on the other hand, the wedges are too thick, there is risk of breaking off the sides of the tenon, or even of splitting the rail.

Fig. 87 shows a good way of joining the sloping piece and bottom rail of a triangular-panelled frame, such as the spandril frame under the stairs in a hall. If the tenons had to be cut out of the solid rail parallel to the bottom, the mortise holes would be so acute as to be almost useless; they would also be extremely difficult to cut. This is overcome by inserting two loose tenons, as indicated, one being fox-wedged while the other is shouldered and slipped in from the bottom. The whole can then be glued and cramped up, which gives a very strong joint.

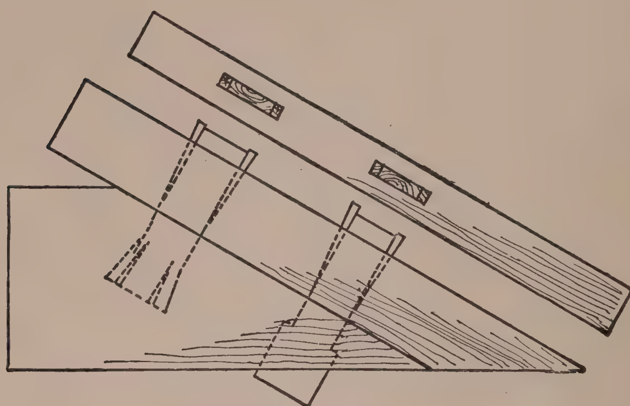


Fig. 87.—Fox-wedged and Loose Tenon Joints

Fig. 88.—Swivel Window

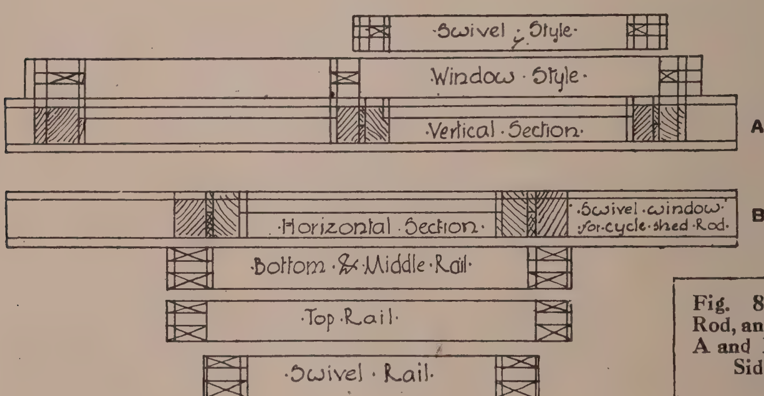


Fig. 89.—Setting-out Rod, and Method of Use; A and B show the Two Sides of the Rod

Use of the Setting-out Rod.—For repetition work a setting-out rod saves much time. As an example, Fig. 88 is the elevation of a small swivel

window for a cycle shed in 1½-in. thick material. All stuff should first be planed straight, true and square, and to the right width and thickness. The setting-

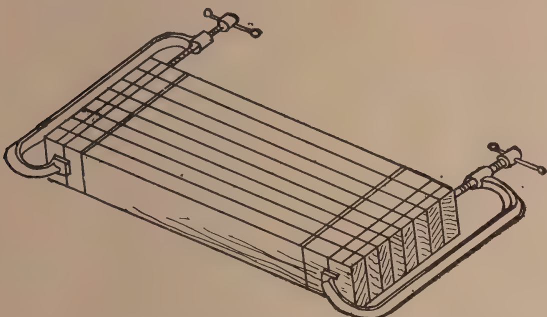


Fig. 90.—Cramping Work while Setting Out

out rod is next prepared in 2 in. by ½ in. wood, planed up smooth and with straight, parallel edges. Fig. 89 shows both sides of the rod when set out, allowing for the rebating and jointing The same illustration also indicates how to apply the rod to the squared pieces, transferring the shoulder lines from rod to stuff. The gauge lines and bevelling are also shown. Setting-out work will be dealt with in the chapter on drawing, and in numerous examples later.

The pieces should first be mortised and tenoned; secondly rebated and the bottom rail weathered; thirdly, fitted together joint by joint and finally glued, wedged up, and c eaned off with the smoothing plane.

It is more convenient, when a number of similar, or nearly similar, pieces have to be dealt with, to clamp them at the ends, as seen in Fig. 90, while the setting-out markings are squared across. This ensures accuracy, and makes all identical parts, such as stiles, rails, muntins, etc, equal in length.

Wedging Mortise and Tenon Joints.—All kinds of tenons used in joiners' work are best secured with glue and wedges, unless they are of sufficient thickness to make a pin more suitable. As a rule, joints where glue is employed should be wedged, while others should be pinned. There are exceptions, but they are few, and rarely found in practical work.

In Fig. 91 are given sectional examples of how and how not to cut out the "wedging" for a mortise and tenon joint. Thus at H a double tenon is inserted in mortises where the wedging is cut out very abruptly, so that the wedges have not a fair opportunity. At I is seen the opposite extreme, a parallel wedging, which is very unlikely to make a strong joint. The correct wedging is shown at J; it reaches nearly through the wood with an easy taper, hence correctly-made wedges will fit throughout the whole length.

At L, in Fig. 92, is illustrated a properly-cut wedge. Too often they are made as at M, or at even a greater angle, which will not be satisfactory in use.

Pinning Mortise and Tenon Joints.—For ordinary pinning, the joint is well cramped up while boring the hole through the tenon and the two cheeks of the mortise, for doing which a brace and bit is used. A slightly-tapering wooden pin, a shade larger than the hole, is then driven tightly in and cut off flush. This does not make so strong a

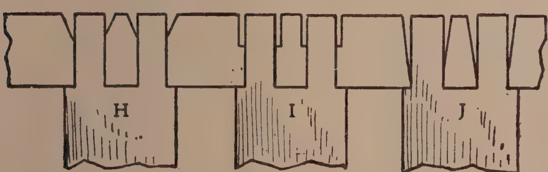


Fig. 91.—Section through Tenons and Mortises; Correct and Incorrect "Wedgings" to Mortises

Fig. 92.—Right and Wrong Forms of Wedges

joint as "draw-boring," to be next described.

Draw-boring.—The best method of pinning is first to bore the hole through the mortise only. The joint is then put together and the position of the hole marked on the tenon by inserting the point of the bit. Next, the pieces are taken apart, and a mark is made on the tenon a trifle nearer the shoulder, as at B in Fig. 93, where A is the one originally made. The tenon is now supported on a piece of waste, the bit inserted at B and a hole bored. On again putting the joint together the holes a e obviously out of line, as seen in Fig. 94. A tapered steel pin, specially supplied for the purpose, is driven through, as in Fig. 95, which naturally has the effect of forcing the holes into line and thereby tightening up the joint. The steel pin is lastly removed and a wooden one substituted.

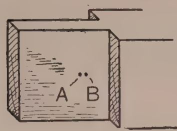


Fig. 93.—Diagram showing Where to Draw-bore the Tenon

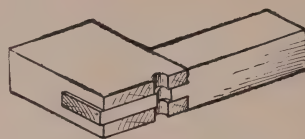


Fig. 94.—Draw-bore Holes Out of Line

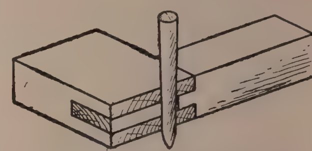


Fig. 95.—Driving Draw-bore Pin through Joint

In the case of a slot mortise shown on an earlier page (*see* Fig. 19), the hole in the tenon should not only be closer to the shoulder, as before described, but should, in addition, be a little farther away from the inner edge, so as to force the tenon up to the end of the mortise. This is usual y a trap for the inexperienced.

The displacement of the central hole in draw-boring must be only of the slightest, or there is a risk of splitting the pin, or possibly of breaking the tenon. A few trials will soon show how much to allow.

Scarfing and Other Joints

Scarfing Joints.—Scarfing joints are used to connect timbers in length, and might better be termed splicing joints. They are numerous, varying from the simple to the elaborate, according to the part they have to play. Thus, for a wall plate, a common halving joint is all that is needed; while in heavy constructional carpentry, as for lengthening posts, beams, struts, tie-pieces, etc., something much more substantial and secure is essential.

The joint should always be selected

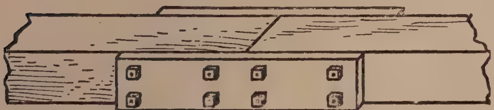


Fig. 1.—Butt Joint with Fish-plates

to suit the particular work in hand. Thus, in the case of a tie beam there is a pulling or tensile strain; a girder is subject to a bending strain; a column to compression, while any of the foregoing might also have to resist a shearing strain, or sliding pressure

Fig. 1 illustrates a very simple form of scarfed joint, in which the two pieces are merely butted together and held in position by a couple of fish-plates bolted on the sides. It is satisfactory for work not subject to vibration, and supported entirely by a wall or by columns at short intervals. If movement is likely, the bolts will wear the wood and the joint will fail. Since stout plates and bolts are imperative, it is only suitable for heavy work. When plates projecting outside are inadmissible, the joint may

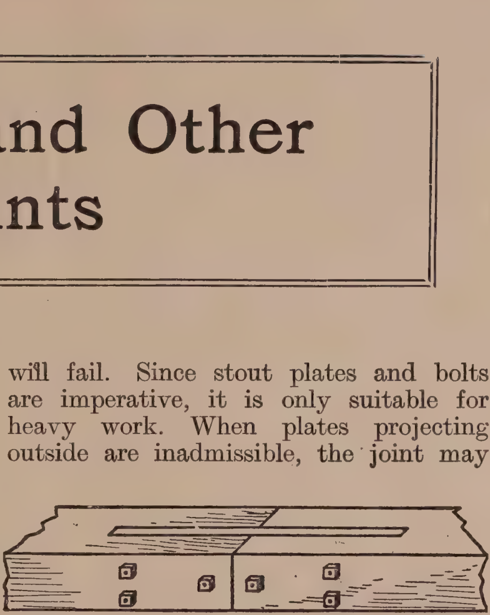


Fig. 2.—Butt Joint with Central Fish-plate

be made as in Fig. 2, a slot being cut in the middle at each end and a single plate inserted. This takes longer, and is not so strong.

Splayed Scarf Joint.—Fig. 3 shows a splayed scarf joint, or plain splice. It is easy to make, but is only used in light work, as, for instance, the joint between the ash bend and straight in the leading edge of an aeroplane, for splicing broken cart shafts, broken oars, etc. In dry work the pieces are secured by screws and glue; while, where wetting is likely,

Fig. 3.—Splayed Scarf Joint

bolts, iron plates and screws are necessary. The splice should be at least 9 in. long, or, better still, 1 ft. If the pieces are equal in size the setting out may be

done by measuring off the required distance, squaring over, and connecting the lines diagonally; otherwise one piece should be cut first and the other marked

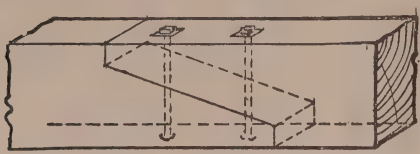


Fig. 4.—Splayed Scarf with Shoulders

by it, laying them out in a straight line while doing so.

Splayed Scarf with Shoulders.—Fig 4 shows a splayed scarf joint with shoulders and bolt fastenings. This is suitable for heavy work and will resist a lengthways push better than the simple splayed joint.

Birdsmouth Splay Joint.—Fig. 5 illustrates the birdsmouth splay joint,

Fig. 5.—Birdsmouth Splay Joint

Fig. 6.—Setting Out Birdsmouth Splay Joint

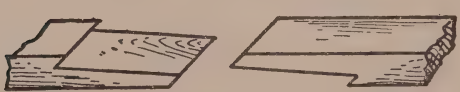


Fig. 7.—Finished Parts of Birdsmouth Splay Joint

which to some extent resists a bending stress. Fig. 6 shows the setting out, and Fig. 7 the two parts ready for putting together. If several of these joints are required it is worth while making a template, especially with timber of unequal size.

An elaboration of the preceding is the splayed scarf with folding wedges and inclined shoulders (Fig. 8). The hardwood wedges pull the pieces together tight, helping to take any tensional stress that may be put on, and thus relieving the bolts. It is used in bridge building, shoring, strutting, etc. Fig. 9 shows the employment of the same joint in an

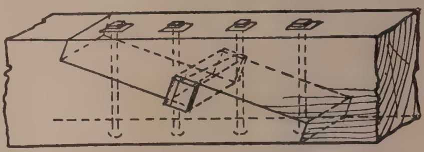


Fig. 8.—Splayed Scarf with Folding Wedges

aeroplane, for the main plane spar, which is too long to be in one piece. It is cut, fitted in close contact, glued, wedged and dowelled, as shown, forming a very strong joint indeed. This and all other aeroplane joints are wrapped round with glued tape, for extra strength.

Slot Mortise and Tenon Scarf.—This joint (Fig. 10) is one of the strongest and most useful in carpentry, and is suitable for splicing very large timbers. Although easy to make, it is important that the parts should fit correctly without being tight, otherwise there is a difficulty in putting together. Fig. 11 shows how to set out the joint. The width is divided into four parts, and a series of equal lengths are measured off, usually six inches each. In Fig. 11 only three of these are shown to save space, but in Fig. 10 four have been used, two in the middle and one at each end, the joint being thus 2 ft. long. Obviously it could be made longer by having five divisions, three being in the centre, as shown by Fig. 12. The best way of putting together is to drop one piece into position while the other is

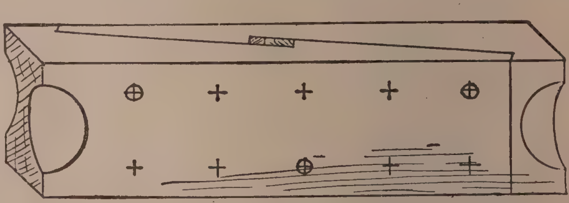


Fig. 9.—Splayed Scarf Joint for Aeroplane Work

lying in place. Fig. 13 shows the two parts ready for doing so. Pins and draw-boring are mostly used for fixing, though bolts are sometimes employed.

When boring the pin-holes, prior to marking, two should be bored through the slot mortises in each piece. This type of joint may be further strengthened, if desired, by making certain members pointed, as indicated by the dotted lines.

Tabled Joint.—Fig. 14 shows a tabled joint, practically a hook halving. It is easy to make, and is useful where longitudinal stresses (tension and compression) are encountered, but not so good for a lateral bending strain. It is greatly improved by the addition of wooden fish-plates at the top and bottom, overlapping 1 ft. at each side of the joint and having four bolts run through. The fish-plates should be the same width as the beam, so that the bolts may be placed zigzag, while the thickness of the plates should be about one-quarter the depth of the beam. Like the preceding joint, certain parts may be pointed if preferred, as shown dotted in Fig. 15.

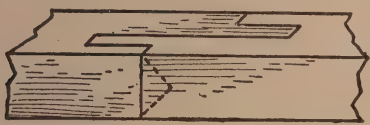


Fig. 10.—Slot Mortise and Tenon Scarf

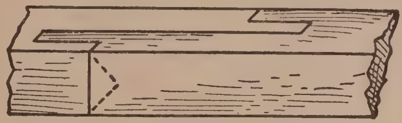


Fig. 12.—Longer Slot Mortise and Tenon Scarf

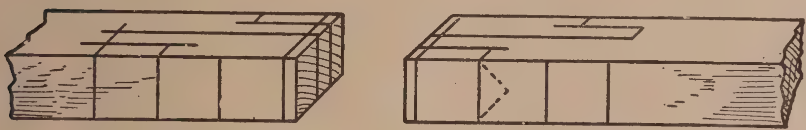


Fig. 11.—Setting Out Mortise and Tenon Scarf

Fig. 13.—Slot Mortise and Tenon Scarf Apart

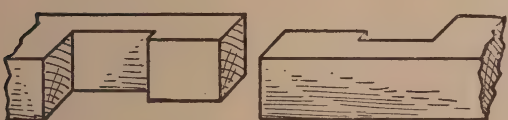


Fig. 14.—Tabled Joint

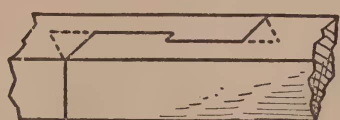


Fig. 15.—Finished Tabled Joint, showing Pointing

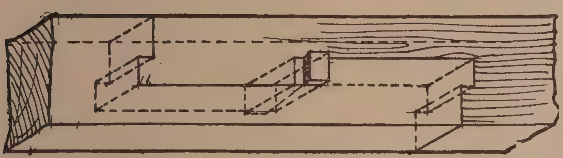


Fig. 16.—Tabled Joint with Folding Wedges

An elaboration of the tabled joint, with folding wedges, used in heavy engineering work, is shown by Fig. 16. Another one, very similar, but having a vertical check to prevent side motion, is illustrated by Fig. 17. When well made this is very effective and needs no other fastening than the folding wedges, but if constructed in a slovenly manner it cannot be recommended. Fig. 18 shows the pieces apart. The seating for the wedges should be so cut as to allow a

slight amount of draught, so that the parts will be forced together when the wedges are driven in.

Double-splayed Scarf Joint.—A double-splayed scarf joint with shoulders at top and bottom is illustrated by Fig. 19. It should only be used when there is substantial support immediately underneath, and should be fixed by bolts and straps, as seen sectionally in Fig. 20.

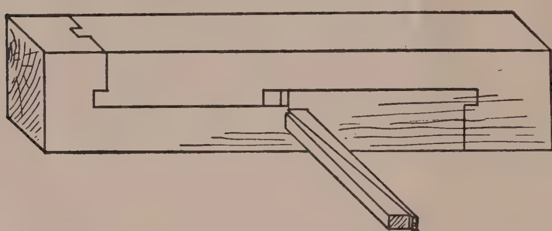


Fig. 17.—Joggle Halving Joint

posts, each piece has what are actually two stopped rebates cut in it, as shown by Fig. 22, one quarter of the area of each section being cut away at alternate corners.

Hammer-headed Key Joint.—This strong and useful joint, illustrated by Fig. 23, consists of a slot so cut in the two pieces as to accommodate a hammer-headed key, sufficient space being left for the insertion of four folding wedges, which pull the joint up tight. In making it great care should be exercised. The key should first be made, in hard wood of a non-splitting nature, and the recess marked direct from the key, making allowance for wedges and fitting. When placing the wedges, note that they are in contact from top to bottom of the hole

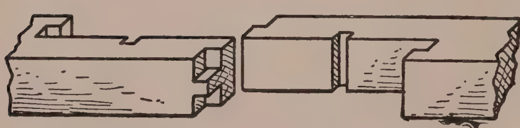


Fig. 18.—Parts Cut for Joggle Halving

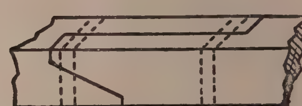


Fig. 19.—Double-splayed Scarf Joint

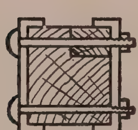


Fig. 20.—Section of Bolts and Straps for Double-splayed Joint

Fig. 21.—Double-splayed Joint Apart

If bolts are employed without straps, and there is the least movement, the wood will gradually wear away and the joint loosen. The two pieces, ready for fixing, are shown by Fig. 21. To set out, divide the length into five parts, taking two parts for each splay and leaving one in the middle for the square. The total length may vary from eighteen to thirty inches.

MISCELLANEOUS JOINTS

Double-halved Longitudinal Joint.—In this, which is very suitable for heavy

on their sloping sides, otherwise they will tend to tilt the joint out of truth.

Fig. 24 shows the application of a hammer-headed key joint to a circular-headed frame.

A simpler joint for connecting two light curved pieces end to end, when no great strain is expected, is by means of a double dovetail key (*see* Fig. 25).

Screwed Joints for Curved Work.—When part of the woodwork is hidden behind brick or stone on one side, and has plaster or wood linings on the other, an easy way for joining curved pieces is by a screwed-on overlapping piece, as

shown by Fig. 26. This method is very extensively used in the building trade.

The joint where the straight side of a window or other frame meets the curved head may be treated as in Fig. 27. Here glue is employed as well as screws.

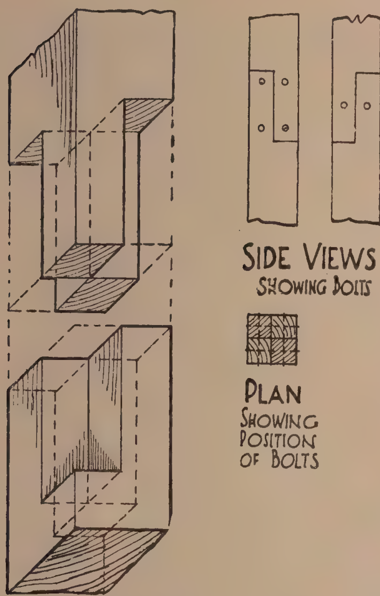


Fig. 22.—Double-halved Longitudinal Joint

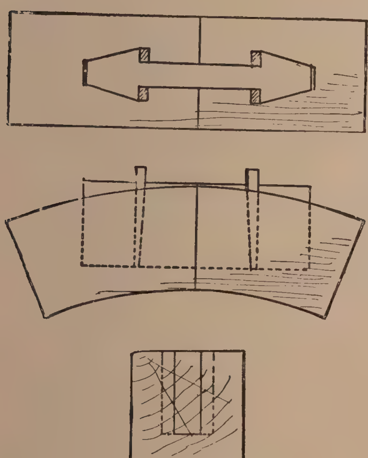


Fig. 24.—Hammer-headed Joint on Curved Frame

Handrail Bolts and Dowels—A very strong type of joint, used in handrailing, heavy curtain poles, wooden curb fenders, etc., is shown by Fig. 28. The bolt holds the pieces close, while the dowels prevent rotation. The nuts are

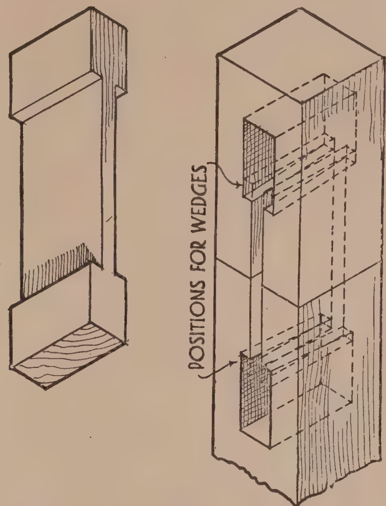


Fig. 23.—Hammer-headed Key Joint

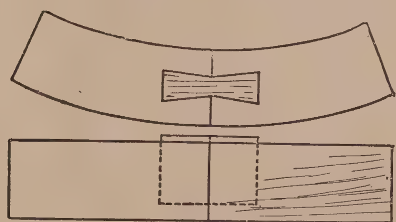


Fig. 25.—Curved Joint with Double Dovetail Key

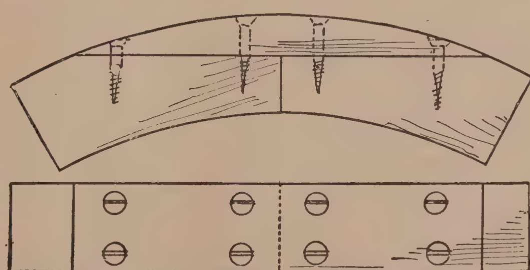


Fig. 26.—Lapped and Screwed Joint in Curved Frame

circular, with grooves cut round the edges, to facilitate tightening with hammer and punch.

Screw Dowel for Walking-stick.—The usual method of attaching the handles to umbrellas and walking-sticks is indicated by Fig. 29. A hole is bored in each piece the width and half the depth of the screw shank, and continued forward with a smaller bit so as to allow the thread to catch. The holes must be big enough or the stick will split; but, on the other hand, if made too large, the pieces will soon come apart, as most people have had melancholy experience. The joint is fixed by glue.

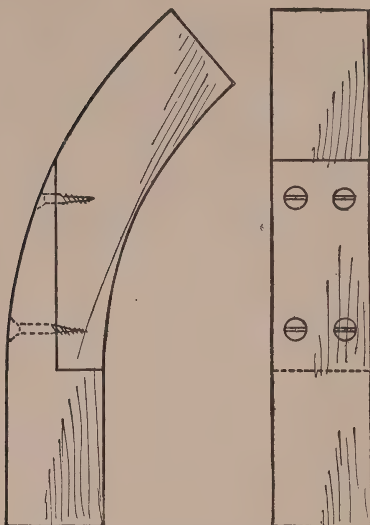


Fig. 27.—Screwed Joint between Curved Head and Stile

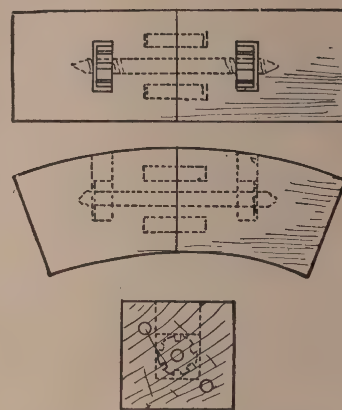


Fig. 28.—Curved Head Jointed with Handrail Bolts and Dowels

Fig. 29.—Screw Dowelled Joint

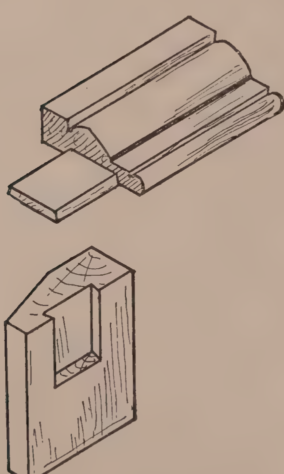


Fig. 30.—Architrave Joint

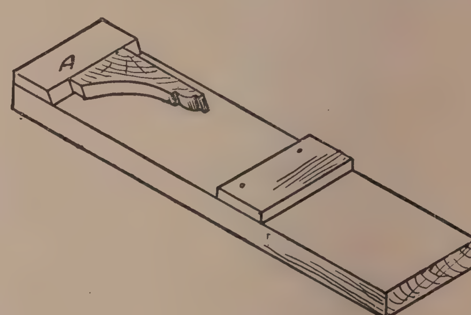


Fig. 31.—Planing Board for Short Breaks in Mouldings

Architrave Joint.—Fig. 30 shows a good way of jointing the bottom end of an architrave with the plinth block of a door or window. It is held in position by glue and screws.

Short Breaks in Moulding.—Fig. 31 illustrates the planing board used for

making short breaks in mouldings, as when continuing a cornice round a pilaster. A small piece of moulding, or several such, has to be cut, which is too short to be held in the vice or on an ordinary shooting board. In such cases it can be planed by placing on the special board against the bevelled stop A, as shown, and nailing it down, punching the nails in a little.

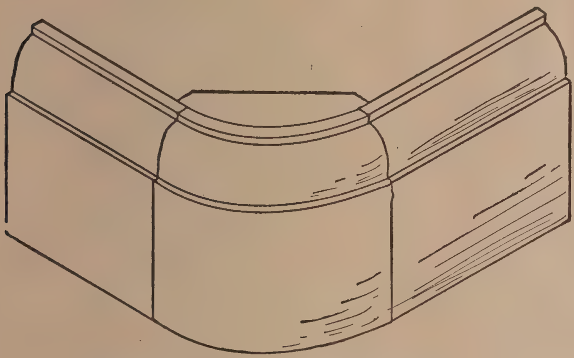


Fig. 32.—Joint for Curved Skirting

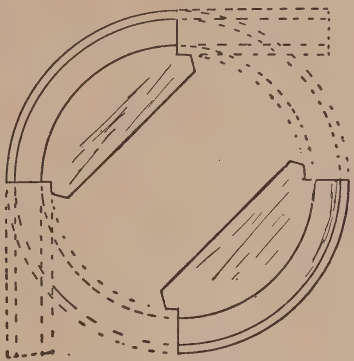


Fig. 33.—Method of Making Joint for Curved Skirting

Joint for Curved Skirting, etc.—An excellent and very substantial method of jointing skirting or other mouldings round circular corners is shown by Fig. 32. A block of wood is turned in the lathe to the same profile as the moulding, and is then cut as indicated in Fig. 33, rebating it at each side to receive the straight pieces. In fixing, the back part of the corner block is sunk into the brickwork, plugged and nailed. The same principle can be adapted for cornices, picture and dado rails, etc.; it is also often employed in cabinet-making, where rounded corners are required instead of the sharp arris of the mitre.

Simple Scarfing Joints.—In making furniture and fittings boards are sometimes required to be lengthened where, from the fact that the work is otherwise supported, simpler methods than those previously dealt with will very well suffice. In mantel-boards and small shelves, for instance, two or three dowels will answer quite satisfactorily; in table-tops mere gluing and cramping will do; while in further cases, rebates, grooves and tongues, half-lapping, or adaptations of some of the other joints already described may be used.

Mitre Joints

The ordinary " mitre " is a joint at 45°, as, for example, the corner of a picture frame, the pieces of wood being at right angles. If the pieces to be jointed together do not meet at right angles then the mitres will not be at 45° but at some other angle.

The cutting and shooting of mitres was dealt with in a previous chapter, and mitreing and framing pictures will be treated later. In this section only the chief forms of mitred joints will be described.

Keyed Mitred Joints.—In joinery and cabinet-making the simple glued mitre would not be strong enough, but has to be strengthened, most commonly by inserting keys or tongues. To make a keyed joint, the two parts are fixed together accurately in the vice, and saw kerfs are cut across at the corners, as shown by Fig. 1. It is better not to make the kerfs parallel, but slightly converging, so as to form a kind of dovetail. Having then glued and cramped the joint, pieces of hardwood veneer are glued and driven in the kerfs, any projecting portions being trimmed flush when set. Another way is to leave the keying till after the joint has been glued up. The grain of the veneer should be at a right angle to the joint.

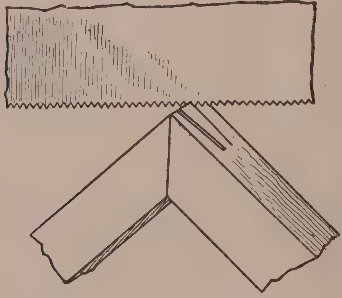


Fig. 1.—Making Saw Kerfs for Keys

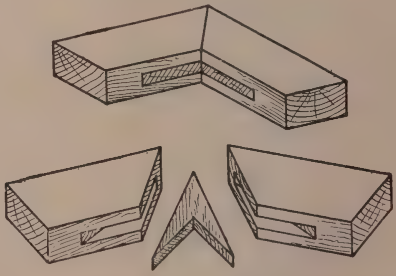


Fig. 2.—Thick Inside Key for Mitre Joint

If the keys are not to show they may be placed inside the corners. The two pieces to be joined are fixed back to back in the vice and marked carefully for the kerfs from each of the faces. A single key of a pointed or arrow-head shape is best.

Thicker and more substantial keys can be used to fit mortises cut at the mitres, an inside example being shown by Fig. 2. The length of the mortise is measured on the end and edge in both pieces, and squared across. The width of the mor-

tise is then marked with a mortise gauge. Kerfs are now made along the gauged lines and the waste chiselled out. The keys are planed to the right thickness and cut to the arrow-head shape to fit, being then glued, inserted, and the joint cramped till set.

False Tenons for Mitred Joints.—Another type of key used in mitre joints is known as a false tenon (see Fig. 3). The one illustrated is square and shows outside, but other shapes may be employed. The method of making this joint is practically the same as that in the preceding paragraph, save that

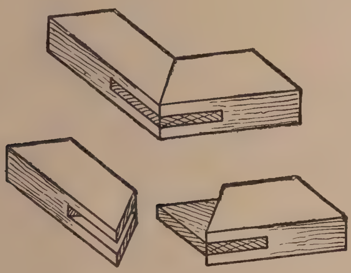


Fig. 3.—Mitre with False Tenon Joint

the saw kerfs for the mortise finish on a line at a right angle with the sides.

Screwed Mitre Joint. — A stout screw may be used to strengthen a mitre joint, a hole being bored just deep enough to countersink the head completely, and stopped up to match the wood after the screw is driven in.

Other Mitre Joints. — Variations of other joints are frequently used for mitred corners. Thus lapped, tenoned, rebated, or grooved and tongued mitres are often met with. These, however, have already been discussed elsewhere. The dovetail-keyed mitre joint (Fig. 4) is more difficult to pull apart than the ordinary types. Dovetail-tenoned mitres, which are still stronger, will be considered when dealing with dovetail joints.

There only remains the case of mitres

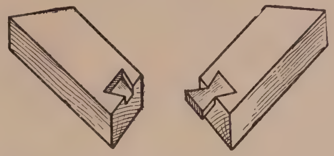


Fig. 4.—Dovetail-keyed Mitre Joint

at other angles than 45°. Fig. 5 shows a six-sided or hexagonal frame with mitred joints. To do work of this kind accurately it is best to prepare a mitre box or block having saw kerfs at the required angle. The sum of the angles in a regular polygon is equal to twice as many right angles, less four, as the polygon has sides. Hence, the sum of the angles in a hexagon $= (90° \times 12) - (90° \times 4) = 1080 - 360 = 720°$. Therefore one of the angles $= 720 \div 6 = 120°$, and the joint is, of course, half the angle, $= 60°$. A shooting board having a triangular block to suit the work is also necessary. The angle of the block facing the shoot should be equal to two right

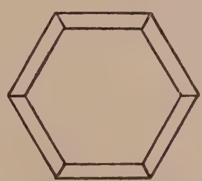


Fig. 5.—Hexagonal Mitred Frame

angles, less twice the angle of the joint. In the present instance this would be $180 - 120 = 60°$. Therefore an equilateral triangle could be used, whose angles are each 60°.

Plain Dovetail Joints

Different Kinds of Dovetail Joints.—The term dovetail joint is almost self-explanatory. It is really a tenon or "pin" of inverted wedge shape, fitting into a similar mortise or socket, and being, therefore, locked in all directions save one. It is important in joinery and cabinet-making, but seldom used in carpentry. Single dovetails, such as the dovetail half-lap, dovetailed housing, notching, etc., have already been dealt with. There now only remain to consider the various descriptions of multiple dovetail joints, as mostly seen on drawers and boxes.

Ordinary or Box Dovetail.—Two ways of arranging this are shown by Figs. 1 and 2. In the first, the pins are cut on the end or side pieces, the mortises or sockets being made in the front and back. In the second, the contrary is the case; the pins are on the front and back, while the mortises are in the ends. Generally speaking, the first method is best, since it displays less end grain on the part most seen (the front), and is therefore neater.

Much of the strength of the dovetails depends on the size and angle of the pins. It is a mistake to think these gain by being large and clumsy. They should be as light as possible, and spaced pretty closely together. Some fancy that an obtuse angle is an advantage. It certainly may have greater holding power, but since the grain of the wood is cut more across in making the pins, there is grave danger of these splitting out when the joint is put together. Thus, the setting shown in Fig. 3 is preferable to that in Fig. 4, both for the reasons given and as regards appearance. A very coarse dovetail, only suitable for carpentry, is shown set out in Fig. 5.

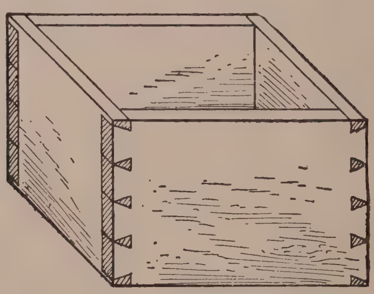


Fig. 1.—Correctly Dovetailed Box

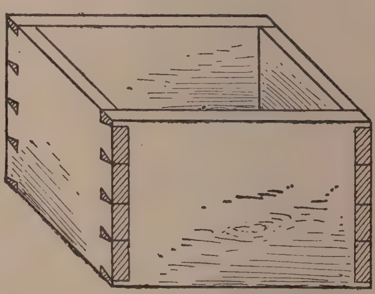


Fig. 2.—Box Incorrectly Dovetailed

Provided all is done carefully and in due sequence, the box dovetail is quite

easy to make. There is an unsettled controversy whether the pins should be made first, or the sockets. The second

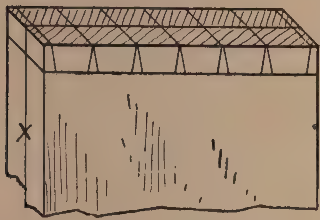


Fig. 3.—Dovetails Correctly Set Out on Front and Back f Box

Fig. 4.—Dovetails Faultily Set Out

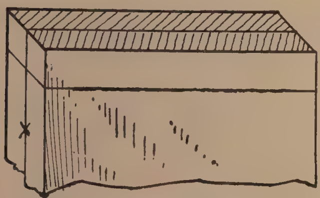


Fig. 6.—Ends of Box with Scribed Shoulder Line

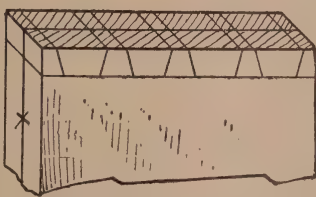


Fig. 5.—Carpenter's Coarse Dovetails, Set Out

way is the quicker, and will therefore be dealt with before the other.

"Sockets First" Method of Dovetailing.—The pieces having been planed, smoothed, and the ends shot true, the back and front are put face to face, in the same position they will occupy when finished, and are fixed together with slight brads, keeping the face edges flush. A line is then scribed all round at a distance from the end equal to the

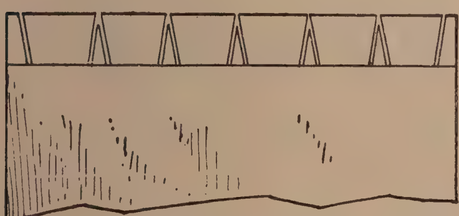


Fig. 7.—Dovetail Sockets Sawn in on Front and Back Piece

thickness of one piece, as shown in Fig. 6. At the two ends of the line mark off half the width of a mortise or socket, then divide the intervening space into as many equal parts, plus one, as there are to be whole sockets. Thus, for five whole sockets there should be six equal divisions. From each dividing line mark off on both sides half the width of a socket and with a bevel set to the correct angle, say 10°, set out the inclined lines, as in Fig. 3. Square the lines across ends (Fig. 19), and, if considered necessary, mark bevels on the other side. Now, with a tenon or dovetail saw, according to the fineness of the work, make kerfs by the side of the lines in the waste, as shown by Fig. 7. In this illustration each pair of saw kerfs meet at the top, but it is sometimes preferred to have the top of the socket a little wider, in which case the cuts would be slightly separated. Having set out and cut the saw kerfs at both ends of the boards, the two are taken apart,

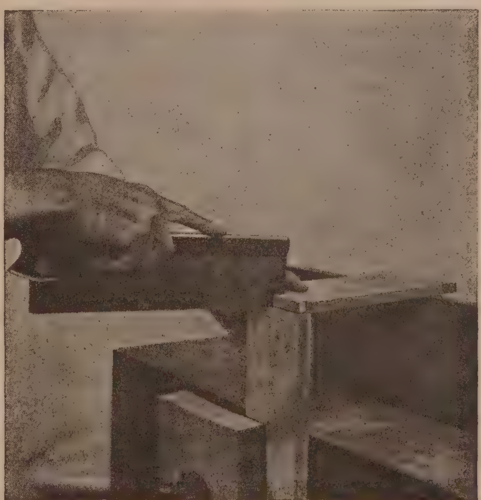


Fig. 8.—Method of Marking Pins on Box Ends

ready to use for marking the pins on the end pieces.

The speediest way of doing this is that illustrated by Fig. 8. One of the

end pieces to be marked is fixed upright in the bench vice with the outer side towards the worker. The front or the back piece is now laid on this at a right angle,

Fig. 9.—Pins Marked and Squared Down

Fig. 10.—Pins Sawn In

inside downwards, with the edges quite level, and the pins can then be marked on the end grain with the point of the saw by inserting the blade in the groove, as

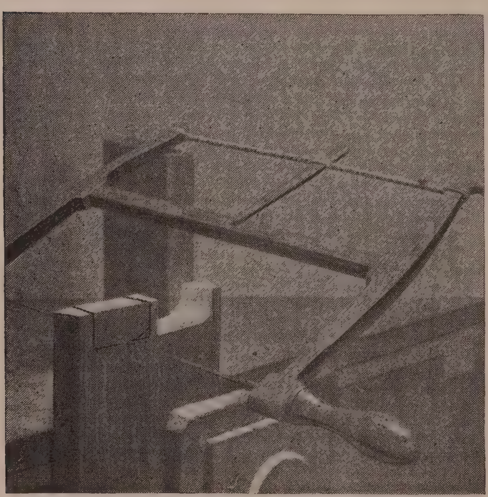


Fig. 11.—Removing Waste from Socket with Bow Saw

shown. Before removing, both pieces should be crossed or numbered for identification when putting together.

The pins are now squared down from the marked lines on the ends to the shoulder lines, as in Fig. 9, and saw kerfs are made to the latter, taking care in this case, to go a trifle outside the marks in the waste, say about $\frac{1}{32}$ in., to ensure a good fit, and keeping the cuts parallel with the squared down lines. Allow a little less for the two half dovetails since if these are tight there is a risk of splitting at the ends. Having reached this stage, the pins will appear as in Fig. 10.

The waste in the sockets may then be removed with a small bevel-edge chisel, or, if they are large, the bow saw may first be employed to cut out as much as possible, as shown by Fig. 11, finishing

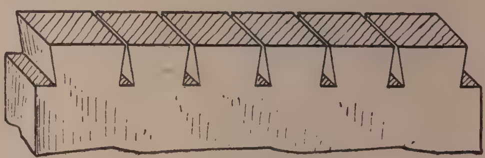


Fig. 12.—Sockets or Mortises Completed

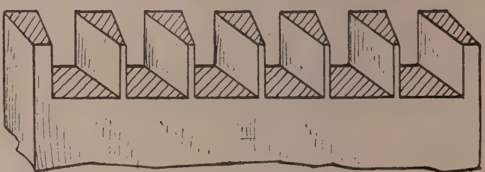


Fig. 13.—Pins Completed

up with the chisel. The half sockets at the ends are, of course, removed with the tenon saw. The sockets when completed should present the appearance seen in Fig. 12. The pins are next finished by cutting out the waste, in a practically similar way, when they will look as shown by Fig. 13. If all has been properly done, the joint should be an exact fit, and only need gluing.

To put together, take one of the ends and glue the pins well and promptly. Stand it on end on the bench and place the front or back piece on it, according to the identification marks previously made, then gently tap it with a hammer until the pins have entered. Next, glue the pins on the other end and engage them in the same way. The two joints now require to be driven home quickly.

using a heavy hammer and a fairly stout piece of wood as a buffer, as shown by Fig. 14. The wood block should be placed directly over the dovetails until

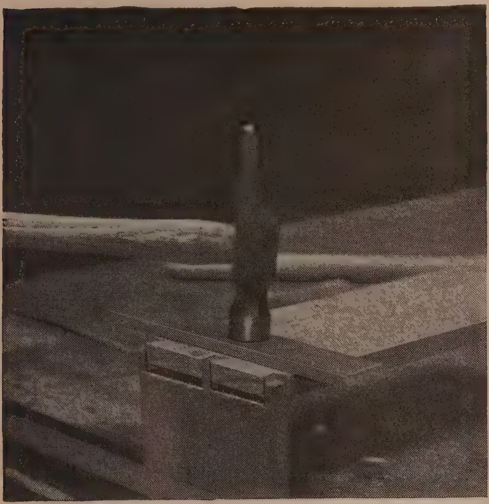


Fig. 14.—Putting Dovetail Joint Together

the pins are level, or come through, and then, if necessary, set just inside them.

The first two joints having been driven home, the whole is turned over and the remaining piece is put on in the same

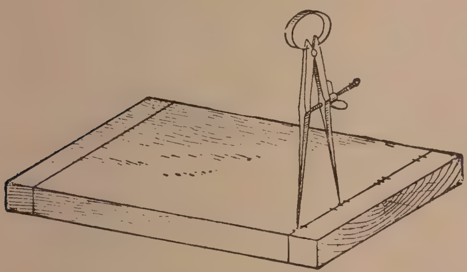


Fig. 15.—Spacing Pins with Dividers

way. In cases where the bottom of the box or drawer fits grooves made all round in the sides, it is obviously inserted before fixing the last piece.

"Pins First" Method of Dovetailing. — While an expert worker will find the "sockets first" system most expeditious, it is perhaps not the best for the beginner, who will usually meet with less difficulty and fewer mishaps by adopting the "pins first" method, at any rate until some dexterity has been gained.

Here the boards or pieces to be joined

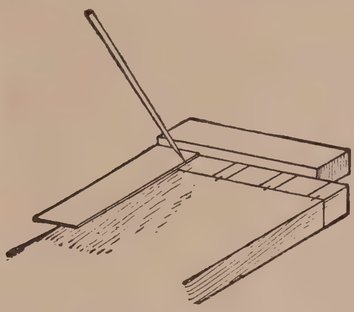


Fig. 16.—Squaring Down the Pins

are planed up and shot true at the ends, as before, and are gauged with a shoulder line all round at a distance equal to the thickness of the material. Next, on the shoulder line and at the outer side of the wood measure off at each end half the thickness of the thinnest side of the pin. With the compasses or dividers divide the intervening space between these marks into as many parts, plus one, as there are to be whole pins (*see* Fig. 15), and on each side of these divisions mark off half the thickness of the pin, as shown.

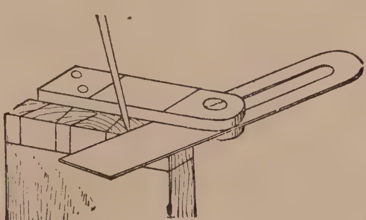


Fig. 17.—Marking Ends of Pins with Bevel

Any slight inaccuracy at this stage will affect the appearance but not the fit of the dovetails.

Next, square down from these marks, as illustrated by Fig. 16, and, with the bevel set to the required angle, say 10°, mark for the ends of the pins, as indicated in Fig. 17; to do which it is best

to fix the work in the bench vice. It is preferable also to square down the lines on the other side of the face.

Then, with the tenon or dovetail saw, make kerfs on the ends outside the lines in the waste, down to the shoulder marks, as seen in Fig. 18; then, with a sharp point, such as that of an awl or of a marking knife, the shape of the pins is marked on the other piece. The ends are next squared across (as in Fig. 19, but singly), and the dovetails are repeated

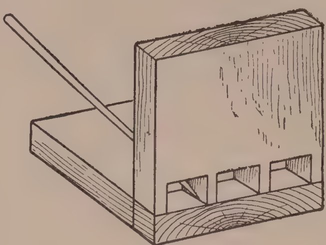


Fig. 18.—Method of Scribing Sockets from Pins

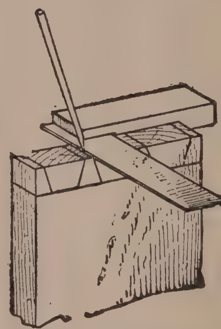


Fig. 19.—Squaring Ends of Sockets

Fig. 21.

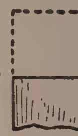


Fig. 22.

Fig. 23.

Fig. 21.—Section showing Waste Cut Away Correctly

Fig. 22.—Section showing Waste Cut Away Incorrectly

Fig. 23.—Section showing Waste Cut Away More Incorrectly

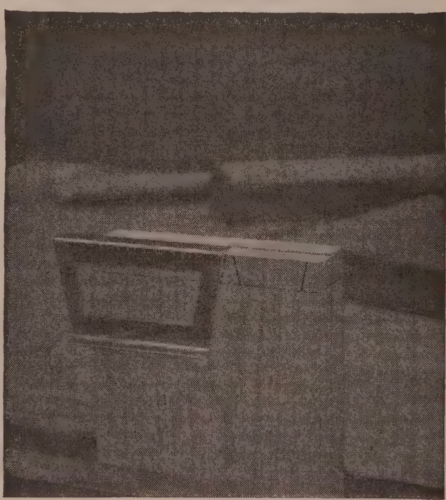


Fig. 20.—Marking Sockets on Two Pieces with Template

Fig. 24.

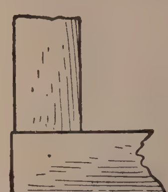


Fig. 25.

Fig. 26.

Fig. 24.—Wood Splitting Through Faulty Removal of Waste

Fig. 25.—Section of Correctly Finished Dovetail Joint

Fig. 26.—Section of Badly Set Out or Faultily Cut Joint

and remove the waste with the chisel, aided, if required, by the bow saw, as before described.

From the finished pins the sockets may now be marked out. The piece for the sockets is laid flat on the bench, and that having the pins is rested vertically on it, on the other side, though this is sometimes omitted. The sockets are lastly cut in a similar way to the pins.

Dovetail Templates. — Instead of using the bevel it is a convenience to have a template of wood or metal, set to the angle desired by the worker, which

should not be less than 10° or more than 15°. Fig. 20 illustrates a metal template, by which the sockets may be marked with accuracy. By putting the dovetailed portion of the template uppermost, it can obviously be employed to mark the pins also, one piece at a time.

Faults in Cutting Dovetails.—In removing the waste between the pins the finishing cuts should be taken on the outside. It will be found at first that there is a tendency to break the wood up instead of cutting it cleanly. To guard against this the chisel must be very thin and sharp, especially with soft wood. The cut should be straight through from side to side, as seen in section in Fig. 21, though it is, of course, performed half from one side and half from the other. Too often the section turns out to be as in Fig. 22, and the joint will tend to open when cleaning off; or, worse still, the section may be as in Fig. 23, when a portion of the wood will be driven out on putting the work together, as shown in Fig. 24. When the setting out and cutting are correct, the finished section will be as in Fig. 25; but if the setting out is careless, or the cutting is carried in beyond the mark, the result will be as shown by Fig. 26.

Pointed Pins.—Some workers prefer to set out the pins a little longer than required, on the ground that this permits the ends to be pointed, as shown by Fig. 27, and makes fitting easier, besides reducing the risk of splitting when putting together. The projecting ends are levelled when cleaning off.

Applications of Simple Dovetailing.—Fig. 28 illustrates a dovetailed tenon joint, such as might be used for a window or similar frame. It hardly

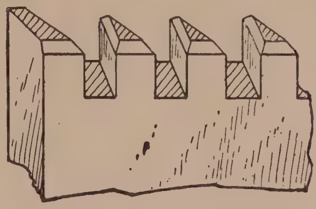


Fig. 27.—Extra Long and Pointed Pins

calls for any explanation. It is the joint commonly used between the meeting rails and stiles of vertically sliding sashes.

Fig. 29 shows the employment of dovetails in carcase work for furniture, when the top board is full width, including the legs. This type of joint is only used when the carcase end is a single board, and not a panelled frame.

Box Pin or Lock Joint.—This joint, sometimes wrongly classed as a dovetail, is extensively used for small boxes, often cut in numbers by machinery. As will be seen by reference to Fig. 30, it consists of a series of alternate notches and square-sided pins on each piece, interlocking and all of the same width. It is a good

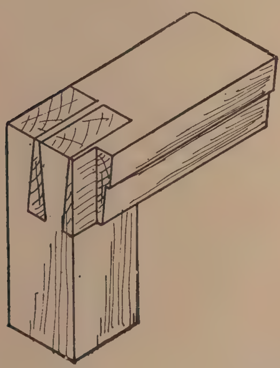


Fig. 28.—Dovetailed Tenon Joint

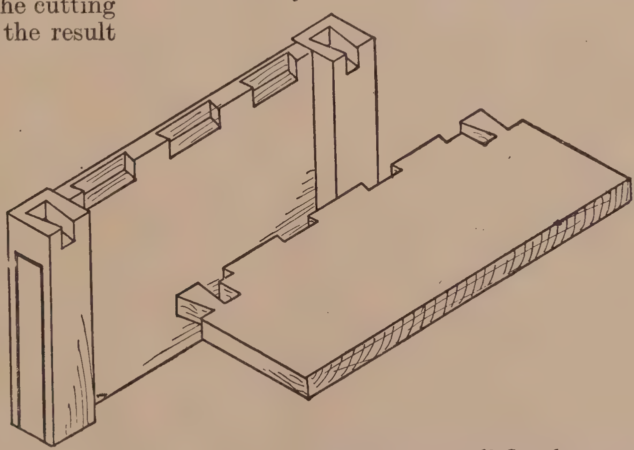


Fig. 29.—Dovetailed Carcase of Small Stand

rule to make the pins as wide as they are thick, though with thin material this is

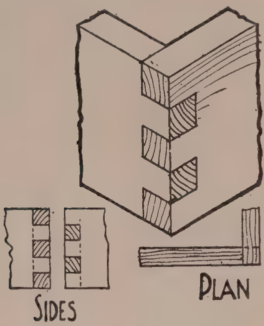


Fig. 30.—Box Pin Joint

not always adhered to. To set out, adjust the cutting gauge to the thickness of the stuff, and scribe a shoulder line all round at the ends of each piece. The dividers are now also set to the thickness, and a number of equal divisions stepped off on the shoulder line of one piece, these marks being squared up to the end. The two pieces are then clamped together in the bench vice, and the division lines squared over the ends of each, and down to the other shoulder line. Before removing, pencilled marks should be made to indicate the notches or parts to be cut out, seeing that the notches on one piece are opposite the pins on the other. The pieces are then taken from the vice and sawn in close to the lines, the waste in the notches being lastly cut out with the chisel and mallet, and finely pared to finish. When doing a number of such joints, a metal template will save much time in setting out.

Lap and Secret Dovetail Joints

Lap Dovetail Joint.—This is chiefly used by cabinet-makers for drawers, being seldom required in joinery or carpentry. Unlike the box dovetail, the end grain only shows on the sides, and is not visible at all on the front, as illustrated in Fig. 1.

When this joint is to be employed it is usual to have the front of the drawer thicker than the sides, and to make the length and width of the pins equal to the thickness of the sides. Therefore, to set out, the marking gauge is adjusted to the thickness of the sides, and a shoulder line A (Fig. 2) is scribed all round at the end of the front. A line B is also scribed along the edge, placing the gauge stop against what is to be the inside of the front. At the same time, a shoulder line may as well be marked all round at the front end of the sides. As will be gathered from Fig. 1, the pins are made on the front and the sockets in the sides.

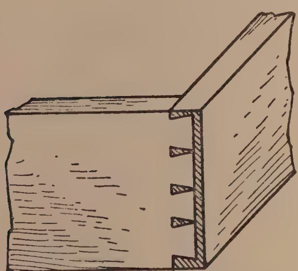


Fig. 1.—Lap or Drawer Dovetail Joint

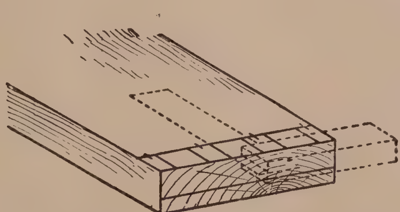


Fig. 3.—Squaring Down the Pins

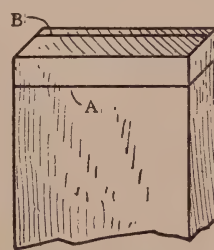


Fig. 2.—Scribing Shoulder and Edge Lines on Front

To set out the pins, mark off half the thickness of the pin from each end of the shoulder line A (Fig. 2) on the front, and with the dividers carefully divide the intervening space into as many parts, plus one, as there are to be whole pins. At each side of these divisions mark off half the thickness of the pin. Then square down the latter marks to the end, as shown by Fig. 3. With either the bevel or a template the dovetails are now marked on the edge, as shown in Fig. 4. Expert workmen usually dispense with the marking.

Next with the dovetail saw held on the slant, kerfs are made slightly outside the lines previously marked, as far as both the gauge lines, the remaining waste being then removed with the chisel. The finished pins should appear as indicated in Fig. 5. It is important to keep the cuts vertical, and not to let them slope outwards as seen in Fig. 6. If that is allowed the joint will fit badly, and there

may be a tendency for the half-pins to split at the ends.

The sockets in the sides of the drawers are marked from the front, placing the end grain of the front towards the end of the side, in the correct position for going together when finished, as shown by Fig. 7.

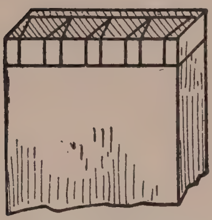


Fig. 4.—Pins Completely Set Out

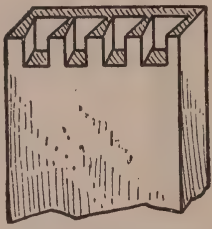


Fig. 5.—Finished Pins for Lap Dovetail

An alternative method is to complete the sockets first in the side pieces, and from them to mark the pins on the front (*see* Fig. 8). Note that, in this case, the front should be fixed upright in the vice, and the side supported over it at a right angle, its end level with the gauge line on the top edge. The piece is then removed, the marks squared down on the face, and the pins cut as before described.

Double Lap Secret Dovetail Joint.—In the single lap dovetail, just dealt with, the sockets are like those of the ordinary box dovetail, only the pin portion displaying any difference, in the lap that prevents a front view of the dovetails.

The double lap dovetail, however, as its name implies, has a lap on each piece; or, more correctly, a lap on one and a stopped end on the other, so that the dovetails are altogether hidden, the external appearance being as shown in Fig. 9. It is, therefore, a form of secret dovetail. The front and sides may conveniently be of equal thickness. Sometimes the pins are made on the front piece, and sometimes on the sides. Logically, it is best to place them on the front of a drawer, from which the greatest pull comes when opening, since the dovetails then help to resist this.

To set out the pins on the front, adjust the marking gauge to the thickness of the stuff and scribe a shoulder line on the inside at the ends, and over at the top and bottom edges, as shown by Fig. 10. Next, adjust the gauge to about one-third the thickness, and scribe a second line parallel with the others, marking it also on the end edge. The pins are then set out with the dividers on the shoulder line, in the manner already described, squared up to the edge, and the dovetails marked on the end with a bevel or template as far as the outer line. With secret dovetails the pins and sockets may be equal in size, or nearly so. The pins can now be sawn in on the slant with the dovetail saw, taking care the cuts are kept vertical, and the waste removed with the chisel, appearing at this stage as in Fig. 11. Cuts are now made with the tenon saw down both the outer lines on the end and edge (*see* the dotted line in Fig. 11).

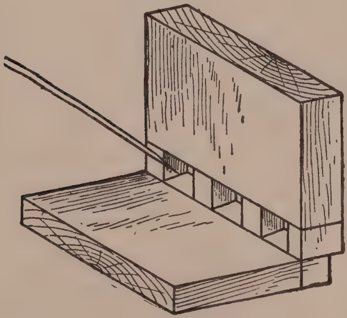


Fig. 7.—Marking Sockets from Pins

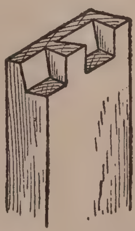


Fig. 6.—Sloping Spaces Between Pins

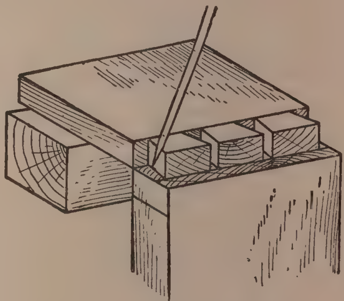


Fig. 8.—Marking Pins from Sockets

until they meet, leaving a lap, as seen in Fig. 12. Some workers prefer to saw away the rebate first before setting out and cutting the pins.

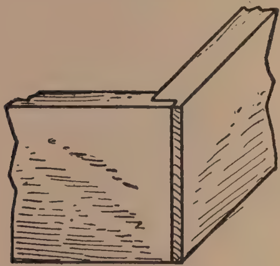


Fig. 9.—External Appearance of Double Lap Secret Dovetail

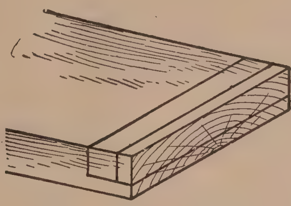


Fig. 10.—Setting Out Drawer Front for Double Lap Dovetail

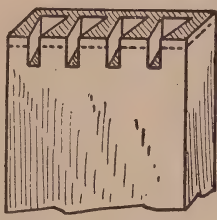


Fig. 11.—Pins Cut for Double Lap Dovetail

To set out the sockets on the sides, adjust the gauge (in this case) to two-thirds the thickness, and mark a shoulder line at the end and on the side edges. Also, placing the gauge stop against what will be the inside of the piece, mark a line on the end edge. The sockets may now be scribed from the pins, as shown in Fig. 13, by placing the side piece level on the bench and standing the front piece vertically upon it, with the rebate close against the edge. The marked lines are next squared over, up to the gauge line on the edge, when the waste may be removed with saw and chisel. The finished sockets should appear as in Fig. 14. When put together, the corner

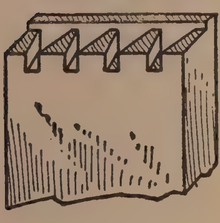


Fig. 12.—Pins Cut and Rebate Formed

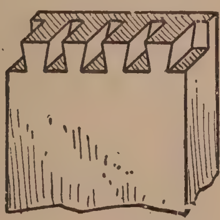


Fig. 14.—Finished Sockets for Double Lap Dovetail Joints

of the double lap dovetail joint is often rounded for better effect.

Secret Mitred Dovetail Joint.—It may reasonably be objected to the double lap dovetail that it looks externally too much like a mere lapped angle joint. On this account it is not much used, since there is but little more trouble in making the mitred dovetail joint, now to be described. As will be seen from Fig. 15, the outside appearance of this is much more satisfactory than either of the two preceding joints.

Both the front and side pieces are set out at first as for the double lap dovetail (*see* Fig. 10). The pins may then be set out and cut, as in Fig. 11, and the rebate formed, as in Fig. 12. Next the rebates are cut out on the side pieces, leaving these for the present square.

The two parts are then placed one on

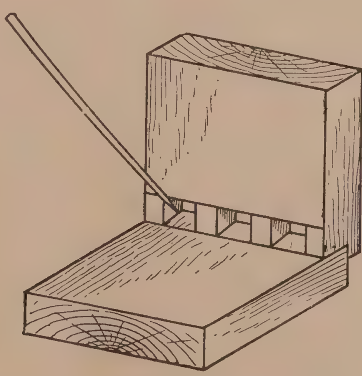


Fig. 13.—Marking Sockets from Pins for Double Lap Dovetail

the other, as shown by Fig. 16, when the sockets can be marked from the pins, as illustrated in Fig. 17. The difference of treatment now commences. First the two projecting laps should be trimmed to

an angle of 45°, either by cutting with a chisel or preferably by using a rebate plane. In the former case, the best way is to cut a mitred edge on a piece of board at the correct angle, and to clamp this shortened pins cannot have so strong a hold; while, since the mitre only shows at the top, there is nothing whatever gained by carrying it all along, save that the joint is somewhat easier to make.

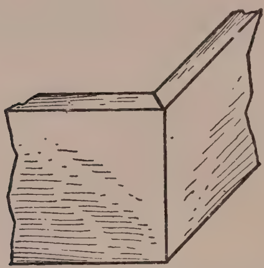


Fig. 15.—External Appearance of Secret Mitred Dovetail Joint

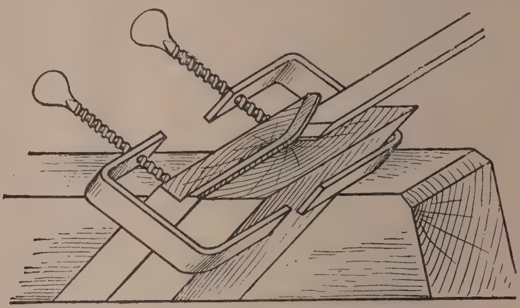


Fig. 18.—Paring Mitre on Lap with Chisel

to the work, as shown by Fig. 18, to act as a guide for the paring chisel. The alternative method of using the rebate plane is illustrated by Fig. 19. The pins and mitred rebate will now appear as in Fig. 20. Next, the half pin at the top end is mitred down, in continuation of the mitre on the lap; there is no need to mitre the bottom half pin unless desired. Figs. 21 and 22 show two secret mitred dovetail joints finished.

Mitred-Through Secret Dovetail Joint.—There is another form of mitred dovetail joint, beloved by the theorist

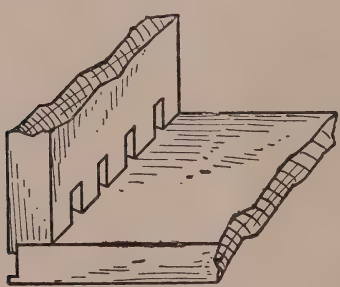


Fig. 16.—Placing Front on Side to Mark in Sockets

rather than the practical man, in which the ends are mitred throughout. Fig. 23 shows how the pins appear when this is done, while Fig. 24 shows the corresponding sockets. It is self-evident that the

Setting out is commenced in the same way as for the other form of mitred dovetail (*see* Fig. 10). Then the two rebates are made, the pins set out on the front, and the rebate mitred. In cutting the pins the saw cuts are taken at an angle of 45°, and the waste is chiselled out at

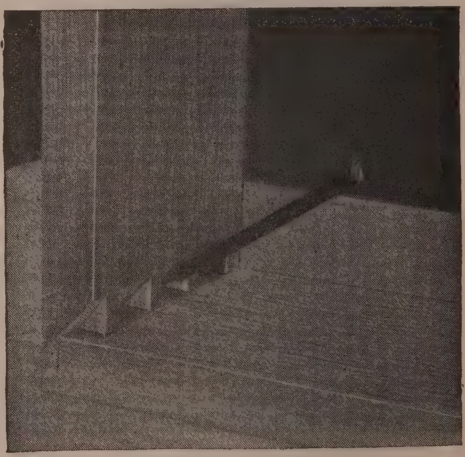


Fig. 17.—Marking Sockets from Pins.
(Note in this method the End Mitres are sawn before the Sockets are Marked)

the same angle, to give the result shown in Fig. 23. The sockets are now marked from the pins, cut out, and the whole end planed to a mitre at 45°, as in Fig. 24.

Oblique Dovetail Joints. — Sometimes it is required to use dovetail joints on a rectangular frame having inclined sides. In such a case it is necessary to set out the whole in plan and elevation, to find the requisite angles for the ends of the four pieces, and for the bevels at top and bottom. The pieces are then cut and planed to these angles and carefully tested to make sure that they go correctly together.

Shoulder lines are now set out parallel to the inclined ends, and the dovetails for the pins are spaced and set out on the end edge of one piece, noting that the centre lines of the pins should be parallel with the bevels at both the top and the bottom.

The pins are then carried down to the shoulder by lines also parallel with the top and bottom, and may be cut out, being next used to mark the sockets.

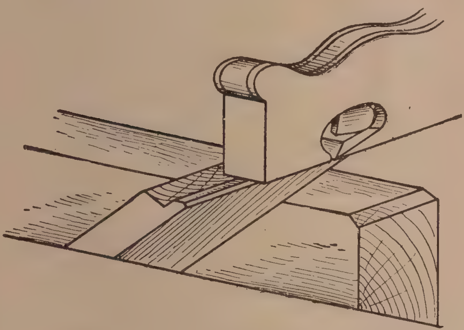


Fig. 19.—Planing Mitre on Lap

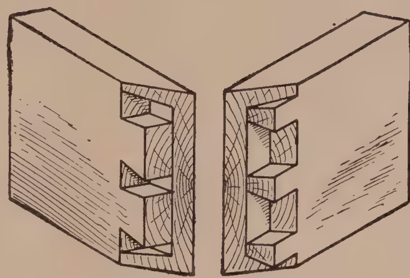


Fig. 21.—Secret Mitred Dovetail Joint

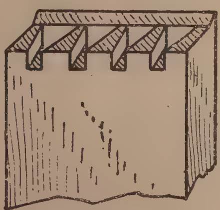


Fig. 20.—Pins Cut and Rebate Mitred

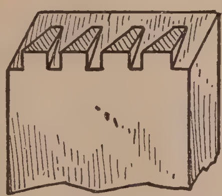


Fig. 23. — Pins for Mitred-through Secret Dovetail Joint

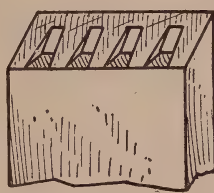


Fig. 24.—Sockets for Mitred-through Dovetail Joint

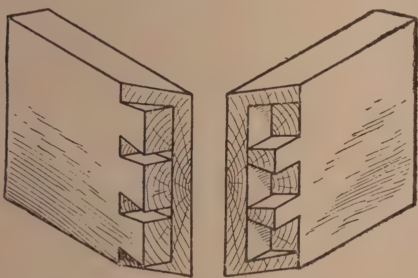


Fig. 22.—Secret Mitred Dovetail Joint with Pins at Distance from Edge

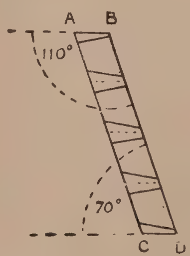


Fig. 25. — Setting Out Oblique Pins on End

Fig. 26.— Setting Out Oblique Pins on Side

Suppose, for instance, the frame or box is to have four sides. all inclined at 70° to the base. Then, Fig. 25 shows the end of one of the sloping sides. A B and

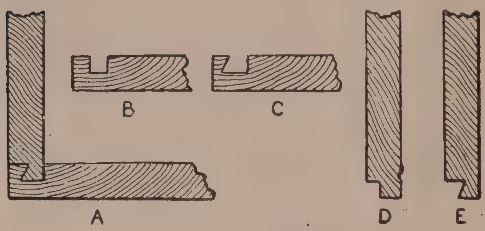


Fig. 27.—How Dovetail Grooves and Tongues are Cut

C D being the bevelled edges at top and bottom.

It will now be obvious that the angle of the bottom bevel is equal to the inclination of the side (70°); while the top bevel is equal to 180° minus the angle at the base, or, in this case, 180 − 70 = 110°.

Fig. 25 indicates the pins set out on the end, the dotted centres of the pins being parallel with the bevels; and Fig. 26 illustrates how the pin lines are carried over to the shoulder line on the front of the same piece.

Dovetail Grooves and Tongues.—One now and then comes across boxes the sides of which have half-dovetail tongues all along their lower edges, and fit into half-dovetail grooves at the bottom, as shown in section at A (Fig. 27). The sides themselves are similarly dovetail-tongued and grooved at the corners. This is practically the same joint as the dovetail housing used for shelves. On a small scale, it may be executed by first making square grooves in the bottom, as at B, and then undercutting one side of the groove with a chisel, as at C. The tongues would be cut first as rebates, as at D, and next chiselled in at one side to fit the grooves, as at E.

The proper way, however, of making the grooves is to do the tongues with a special rebate plane having the iron and bottom set to the correct angle, and furnished with a side stop; while the grooves are cut by tilting the board and doing the dovetail side with a plough plane, having the iron sharpened to the required angle.

The board is then levelled and the square side of the groove done with another iron.

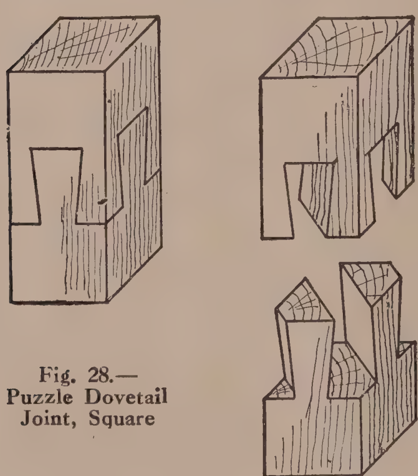


Fig. 28.—Puzzle Dovetail Joint, Square

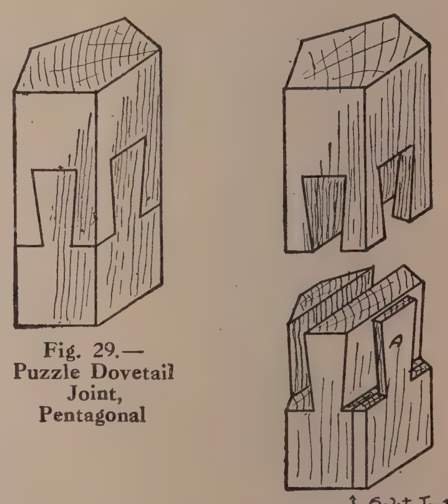


Fig. 29.—Puzzle Dovetail Joint, Pentagonal

Puzzle Dovetail Joints.—Fig. 28 illustrates a puzzle joint in dovetailing two pieces end to end. It is best made in different coloured woods. The pins and slots are marked on the sides of the square, as shown, and cut out sloping with due

allowance for fitting. The joint is then glued up and cleaned off.

Fig. 29 shows a more difficult puzzle joint, and the way to make it is not so obvious as in the previous case. The section is a pentagon, and one is naturally perplexed as to where the other end of the odd pin can be. To construct this joint, two pairs of adjacent sides are marked with pins and slots, and cut out.

The side marked A is a false dovetail, being cut out as shown, and split with a broad chisel along the line indicated. The joint is then fitted without piece A and glued up. Piece A is now glued, inserted, and cramped up close in the split join till the glue sets. The joint is lastly cleaned up with a smooth plane and polished.

This puzzle joint looks well if made in sycamore and black walnut, the latter being the one to split. A piece of straight-grained wood must be chosen.

Ledges and Clamps

Ledges.—Whereas cramps are merely used to tighten up joints while the glue is setting, and are then removed, there is a somewhat analogous method employed for the permanent security of boards jointed together, and known as ledging. It is familiar in common doors composed of grooved and tongued boards, in which case the ledges are merely nailed or screwed across, as shown in Fig. 1. A better form, used for drawing-boards, makes allowance for shrinkage. The middle of the ledge is fixedly screwed, but countersunk slots are cut for the side screws, as illustrated in Fig. 2. Then, if the joints should open, the outer screws can be loosened, the board cramped up, and the screws again tightened. Dovetailed and other forms of ledges are also employed for different purposes.

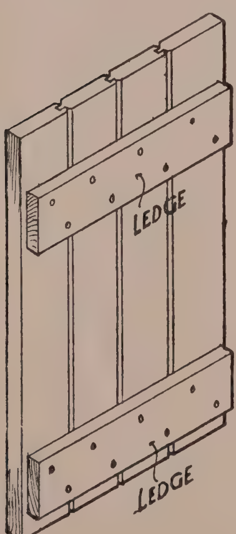


Fig. 1.—Grooved and Tongued Door with Ledges

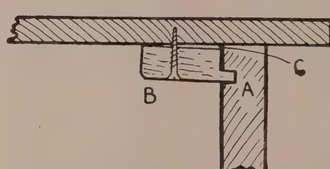


Fig. 4.—Table Top attached by means of Buttons

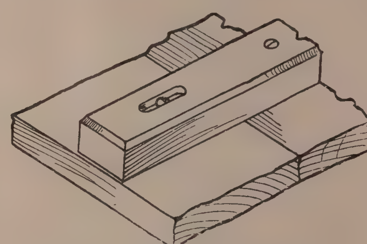


Fig. 2.—Slot-screwed Ledge

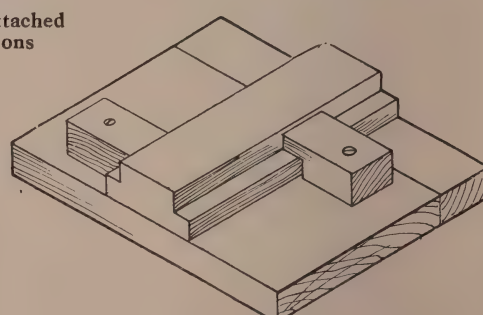


Fig. 3.—Buttoned Ledge

Buttoned Ledges.—These afford a convenient means of adjustment to coun-

teract warping due to shrinkage. Thus, in Fig. 3, the ledge has rebates, over which fit the projecting ends of screwed-on wooden buttons. By tightening one of these or loosening another, as may seem expedient, the work may be rendered flat.

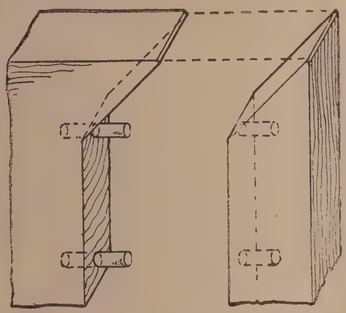


Fig. 5.—Dowelled and Mitred Clamp

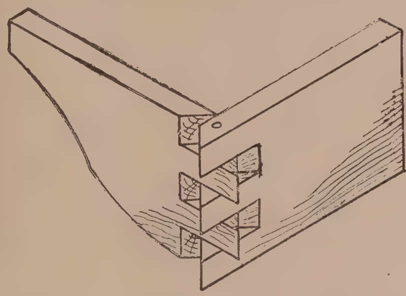


Fig. 7.—Hinged Bearer for Table Flap

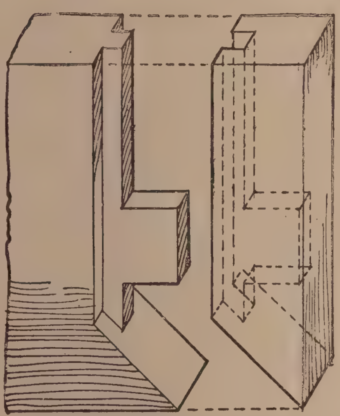


Fig. 6. — Stub-tenoned and Mitred Clamp

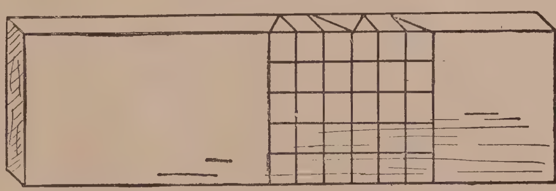


Fig. 8.—Setting Out for Hinged Bearer

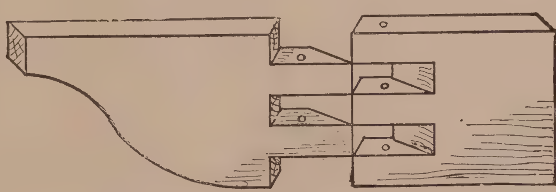


Fig. 9.—Finished Parts of Bearer, Ready for Fixing

An application of the buttoned ledge provides a good way for attaching a table top to the rails. Grooves are cut in the latter, as seen at A in Fig. 4, into which fit the projecting ends of the buttons, one of these being shown at B. The shoulder of the button should be narrower than the distance of the groove from the upper edge of the rail, in order to give a tension to the screw and table top, and thus ensure a close joint between top and rail. This will be understood from the slight space left at C, purposely a little exaggerated.

Clamped Ends.—These must not be confused with the cramping previously referred to. A clamp is an end piece having the grain lengthways, and is used to prevent warping or twisting, besides giving a neater appearance. The ends of drawing-boards, blackboards, etc., will occur to mind as typical examples. The most usual form is probably the tongued and grooved; but rebates, dowelling, and haunched tenons are also employed; all these joints are usually glued and none of them should present any difficulty to

those who have followed the instructions already given under these heads.

For the backing of cupboards and wardrobes a tongued and grooved joint is used without gluing, the outer boards being secured to the framing instead. This allows for shrinkage or expansion due to dryness or dampness.

Mitred Clamping.—To avoid the end grain showing at the corners in cabinet work, mitred clamping is sometimes adopted, which may either be dowelled, as in Fig. 5, or stub-tenoned, as in Fig. 6. The first hardly requires explanation. For the second, the clamp is grooved with the plough and mitred at each end. The haunched tenons and mitres are then set out on the other portion of the work, on which the clamps are to fit, and the waste removed with tenon saw and chisel. The rebate plane may be partly used for the haunching, if long. The clamp is now laid over the tenons and marked for cutting the mortises.

Hinged Bearer for Table Flap.—In concluding this survey of woodwork joints it may be of interest to describe the manner of making the hinged bearer for a table flap, illustrated by Fig. 7. In one sense this is not properly a joint, yet in another it may certainly be considered so. Fig. 8 shows how it is set out, and Fig. 9 how it is cut. Having bored the holes in line in each piece, an iron rod is lastly inserted to form the hinge-pin. Take care to saw just inside the waste to ensure a good fit.

Boring Tools and Their Uses

THE BRADAWL

The chief boring tools are the bradawl, the gimlet, and the brace and bit. For small holes, say up to about $\frac{1}{8}$ in. or $\frac{3}{16}$ in., the bradawl (or sprigbit) is generally used, particularly if the holes are only a few in number. When nailing softwoods, say with nails up to about 2 in. to $2\frac{1}{2}$ in. in length, and if there is a danger of splitting owing to the nails being near the edge, the nails are "given a start" by boring part-way with the bradawl. Screw holes in softwoods are bored in the same way. Holes for nails or screws, in hardwoods are bored with the bradawl only if they are very small, the brace and bit being generally used for larger ones.

Fig. 1.—Ordinary Bradawl

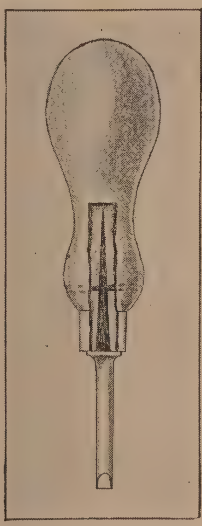


Fig. 2.—Section of Bradawl having Pin through Tang

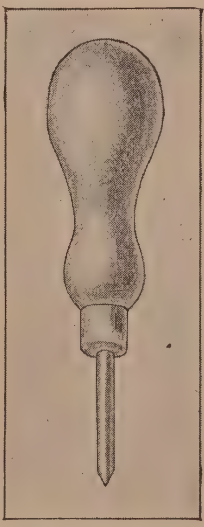


Fig. 3.—Bradawl Secured by Ferrule

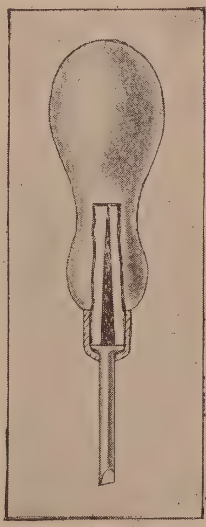


Fig. 4.—Section of Bradawl Secured by Ferrule

The common type of bradawl is shown in Fig. 1. It consists of three parts: the handle (preferably ash, but often beech), the ferrule of brass, and the blade

(or prong or bit). The blade has a tang which fits into the handle. Between tang and blade is a shoulder which prevents the blade being driven into the handle. Fig. 2 shows a section of a

Fig. 5.—Bradawl and Tool-pad with Wing-nut Adjustment

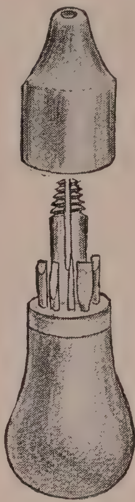


Fig. 6.—Bradawl and Tool-pad

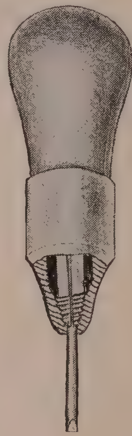


Fig. 7. — Section of Bradawl, showing how the Jaws Grip the Blade

bradawl having a pin passing through the handle and tang and thus preventing the blade from being easily withdrawn from the handle, this being a decided advantage.

Fig. 3 shows an even more securely fixed blade than the type shown in Fig. 2. After the tang is driven into the handle the cup-shaped ferrule is driven on the handle and holds against the shoulder of the blade (*see* Fig. 4). The tang is then fastened with one or two pins.

There is a number of types of bradawls with detachable blades, as shown in Figs. 5, 6 and 7. Sometimes these elaborate bradawls are known as "tool-pads." The "bits" (or tools) often comprise a small screwdriver, gimlets, reamer, etc.

In the type shown in Fig. 5 the "bits" are kept in the hollow handle, which is usually made of boxwood and has a screw top. The various bits are quickly fixed in the jaw or chuck by means of the wing screw. Care should be taken not to hit the handle of this tool-pad with the hammer, as being hollow it is easily split.

Fig. 6 shows another variety of bradawl and tool-pad. The shanks of the tools fit into the jaws, the top of which is screwed and tapered. On screwing the cap into position the jaws are forced together and grip the shank of the bit, as indicated in Fig. 7.

Using the Bradawl.—Before using, the bradawl should be sharpened. This is usually done by filing the end bevelled from both sides, the bevels being about $\frac{1}{4}$ in. long. The end, of course, is an *edge*, like a chisel, not a point. A *pointed* bradawl is a mere pricker ; it cannot bore. A saw file is generally used for sharpening, though the bradawl could be ground on a grindstone or flagstone if desired. A

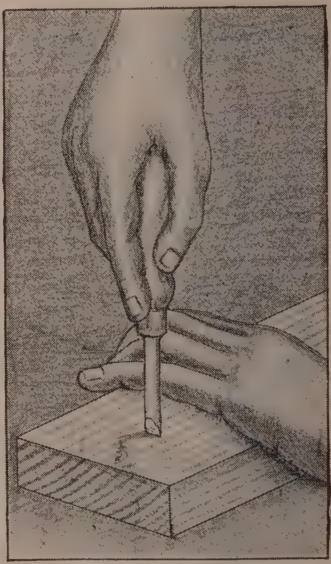


Fig. 8.—Correct Method of Using Bradawl

keener edge may be given by a few rubs on an oilstone, but this is usually not considered worth the trouble.

The cutting edge of the bradawl should be held across the grain (Fig. 8) and pressed into the timber. Whilst pressing on the bradawl it should be slightly

rotated to and fro with an arc-like movement; it should not be turned completely round as in the case of a gimlet. Very often it is driven into the wood with the hammer, as in Fig. 9. This method undoubtedly requires less effort on the part of the workman, but there is a likelihood of the handle of the bradawl being split, and there is also difficulty in withdrawing the tool.

The usual method of withdrawing the bradawl is shown in Fig. 10, the timber being held by the left hand and the handle of the bradawl grasped with the right hand, which exerts a lifting action and at the same time a slight arc-like motion.

If the bradawl is driven into a piece of timber with its edge in the direction of the grain it acts as a wedge and the wood is likely to split, as in Fig. 11. If the edge of the blade is held across the grain there is no wedge action tending to split the wood and the edge also cuts the fibres, thus making a cleaner and

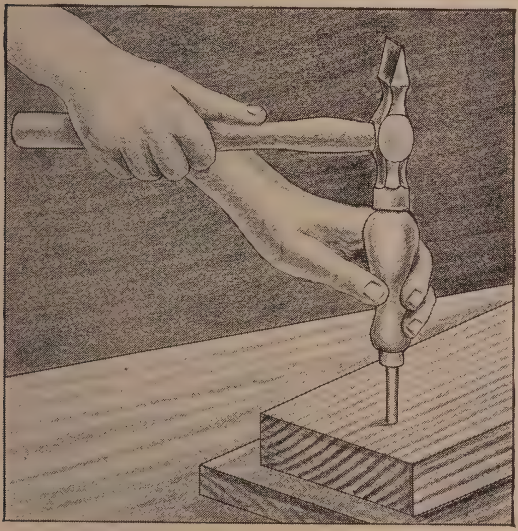


Fig. 9.—Driving Bradawl with Hammer

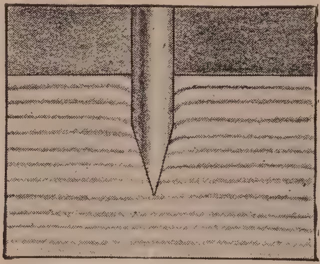


Fig. 12.—Boring Action of Bradawl

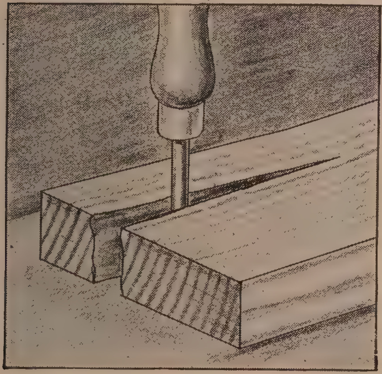


Fig. 11.—Timber Split with Bradawl owing to Incorrect Usage

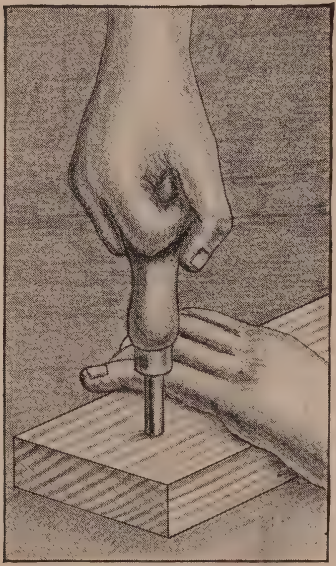


Fig. 10.—Withdrawing Bradawl

larger hole than when the edge of the blade is parallel with the grain. Besides this cutting action there is also a crushing action, the fibres being compressed and bent downwards, as indicated in Fig. 12.

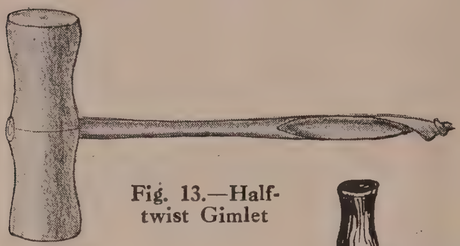


Fig. 13.—Half-twist Gimlet

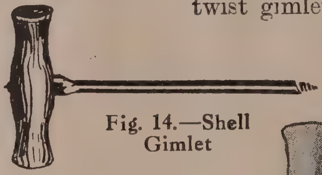


Fig. 14.—Shell Gimlet

GIMLETS

A gimlet is a self-contained boring tool (like a bradawl), but having a twisted or threaded point that forces its way into the wood. In boring a hole with a bradawl continuous pressure has to be applied, but in the case of a gimlet, after it has once been started, the worm end "eats" its way into the timber. The handle is therefore shaped so that a fair amount of turning effort can be applied.

The steel portion of the gimlet is made in various shapes. Fig. 13 shows a common form known as a half-twist gimlet. A shell gimlet is shown at Fig. 14, the bit being a straight shank, half circular in section, with a twist at the end. Fig. 15 shows an auger bit, and Figs. 16, 17 and 18 further illustrate an ordinary form of twist gimlet in course of use.

Using the Gimlet.—To bore a hole with a gimlet it has to be turned constantly in one direction (like the hands of a clock). Fig. 16 shows the usual way of holding when starting to bore. The gimlet is at first rotated and pressed down at the same time. When the point and the cutter have entered the wood, and provided the wood is not too hard or


Fig. 15.—Auger Gimlet

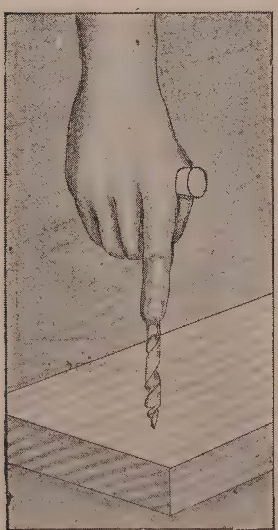


Fig. 16.—Starting Gimlet

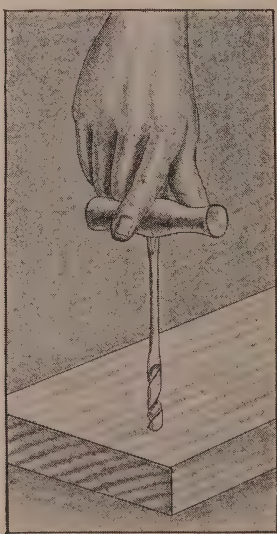


Fig. 17.—Boring with Gimlet

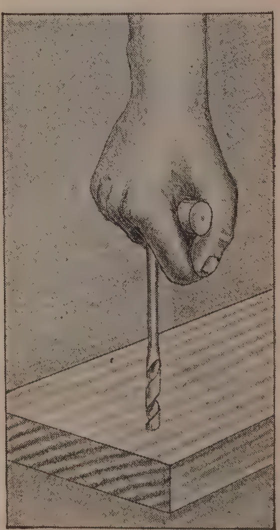


Fig. 18.—Withdrawing Gimlet.

the gimlet dull, the gimlet can be turned more quickly by the thumb and finger, as indicated in Fig. 17.

Fig. 19.—Auger, Gedge's Pattern

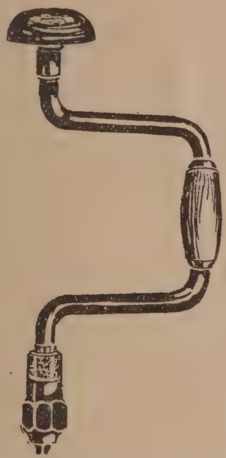


Fig. 20.—Ordinary Type of Steel Brace

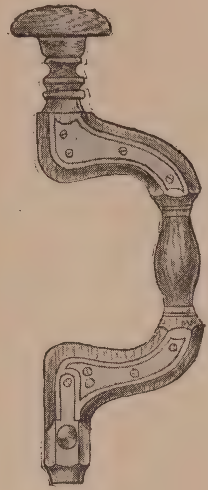


Fig. 20A.—Wooden Brace

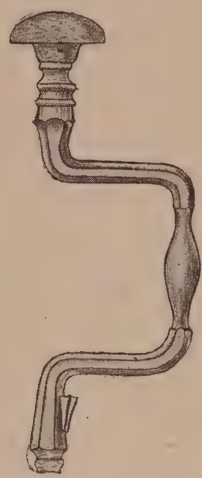


Fig. 20B.—Scotch Brace

The gimlet is withdrawn by grasping the handle (Fig. 18) and using a combined lifting and rotating action; this will bring out the core and leave a cleaner hole. The process just described often has to be repeated several times when boring hardwood or thick softwood.

Care should be exercised in the use of all gimlets when boring near the end of the wood, as they exercise a splitting action. This is especially the case when they become worn and blunt and thus do not cut properly; extra effort is then exerted which brings into play the wedge-like form of their ends, which tends to force the fibres apart instead of cutting them, thus splitting the timber.

Gimlets do not appear to be as much used nowadays as formerly. If a woodworker possesses a brace and bits or a handdrill and two or three bradawls, gimlets are hardly necessary, and, in fact, inadvisable. The chief advantages of the gimlet are its small size and small price.

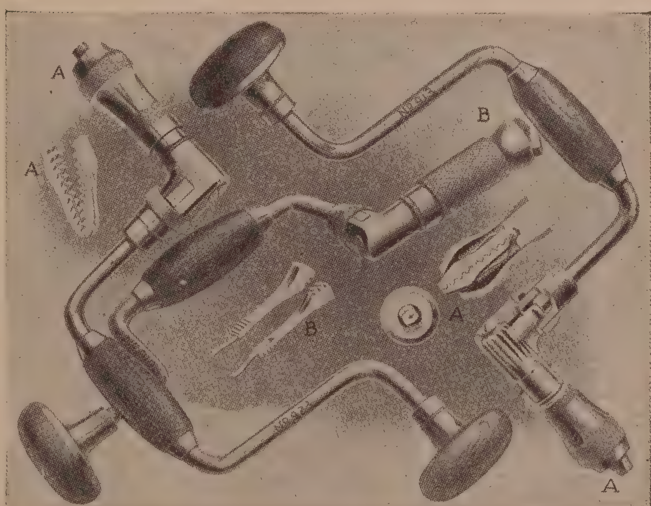


Fig. 21.—Examples of Ratchet Braces and Fittings

An *auger* (Fig. 19) might be described as a large gimlet used for boring large and long holes in carpentry, etc. The handle may either fit through a hole in

the auger shank or the latter may be shaped like a brace bit and fit into a special adjustable handle.

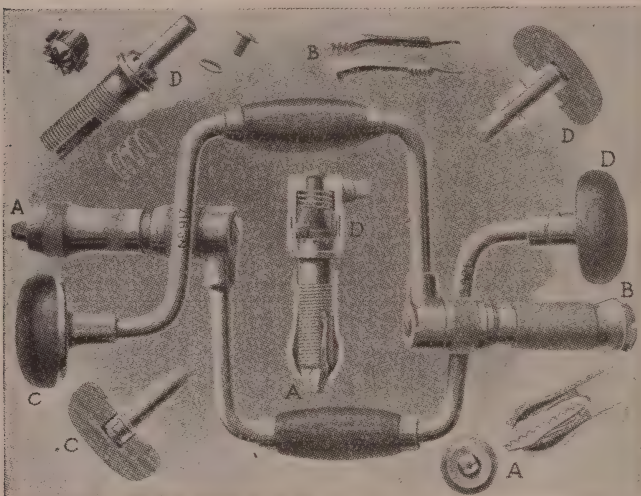


Fig. 22.—Further Examples of Ratchet Braces and Fittings

BRACE AND BITS

A brace is a tool for holding and rotating bits for boring holes and other purposes. The common simple type is shown in Fig. 20. It consists of three parts: the jaws (or chuck), the head, and the crank. Formerly the bit was fastened in the jaws by means of a thumbscrew, as in the old-fashioned wooden brace in Fig. 20A, or by a spring catch as in Fig. 20B, but the usual type of jaws on modern braces is as shown in the illustration. The bit is inserted between the jaws, which grip the bit between them when the jaw cap is screwed down on to the jaws. This latter operation is accomplished not by turning the jaw cap, but by holding it still with the left hand and turning the crank of the brace with the right hand.

Very often the jaws are serrated, as shown in Figs. 21 and 22, in which case they are known as "crocodile jaws," to get a better grip on the bits.

The power of the brace depends on the "sweep" of the crank—the bigger the sweep the more powerful being the brace. The sweep is the diameter of the circle that the crank describes. A 10-in. sweep is a usual size, though 8 in. is fairly common. Other sizes of braces may be also obtained. Though more turning power can be exerted when the crank is large, it is found in practice that a 10-in. sweep gives enough power for all ordinary purposes. The handle of the crank and the head are usually made of rosewood. In good makes the head runs on ball-bearings.

Many braces, in fact, probably the majority in use by professional workmen, are now fitted with a ratchet. Stanley ratchet braces are shown in Figs. 21 and 22; the letters in the illustrations show to which braces the various fittings belong, parts A belonging to brace A, etc. The ratchet is simply a catch or

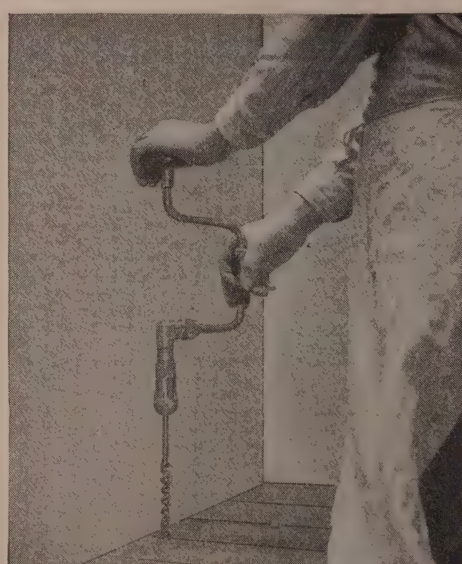


Fig. 23.—Boring Hole with Ratchet Brace in Floor near Wall

device which, at will, enables the crank to be rotated without rotating the jaws and bit. This adds greatly to the utility

of the tool. Fig. 23 shows a hole being bored in the floor near a wall with a ratchet brace and a twist bit. A hole could not be easily bored in this position with an ordinary brace, as the crank of the brace could not be turned continuously. With the ratchet brace, the ratchet may be so adjusted that on turning the crank clockwise the bit is turned. When the crank has thus been turned as far as possible, that is, until it comes in contact with the wall, it may be turned backwards, during which latter turn the bit remains stationary. The crank is again turned clockwise and turns the bit, and so on until the hole is bored. The ratchet may also be adjusted so that the ratchet misses on a clockwise turn and grips on the anti-clockwise turn. Fig. 23A gives a pictorial view showing how the ratchet works; the crocodile jaws are also clearly shown in the illustration.

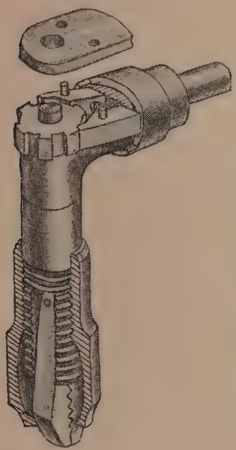


Fig. 23A.—Sectional View showing Ratchet and Jaws

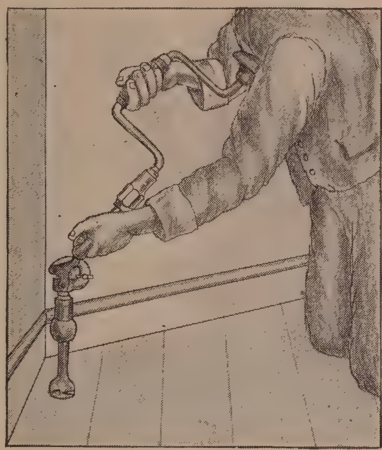


Fig. 23C.

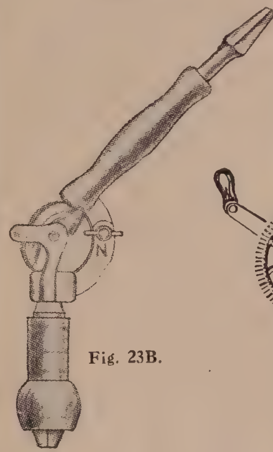


Fig. 23B.

Figs. 23B and 23C.—Angular Bit Stock and How to Use It

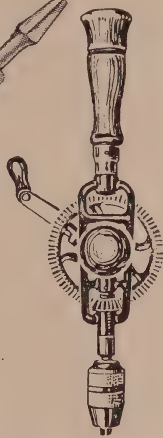


Fig. 24.—Hand Drill

Figs. 23B and 23C show an angular bit stock; it is an alternative to the ratchet brace in awkward positions; N (Fig. 23B) is the clamp.

HAND DRILL

This tool (Fig. 24) is better for many purposes than the brace, and deserves to be better known. Owing to the gearing forming part of the tool, the bit can be turned at a higher speed than with a brace, and, further, the turning of the handle of the drill does not have a strong tendency to pull the drill and bit out of its correct direction. These are two decided advantages. The tool is recommended to both amateurs and skilled craftsmen.

BRACE BITS

There are many varieties of bits, different patterns having been found necessary for boring h les under differing conditions, such as size of hole and kind of timber. Other bits are necessary for drilling and enlarging holes in metal fittings for woodwork and for other purposes.

Fig. 25.—Shell Bit

Fig. 26.—Spoon Bit

Shell Bit.—This bit (Fig. 25) is the simplest and mostly used type of bit.

It is employed only to bore small holes (up to about $\frac{3}{8}$ in. diameter) generally for screws and nails. It is sharpened by filing the end. This bit has less tendency than any other type of bit, when boring a hole through a piece of wood, to splinter the back side, but even with this it is better to safeguard against splintering by holding a scrap of timber to the other side of the wood. This warning applies particularly to such jobs as boring the holes for a keyhole.

Fig. 27.—Nose Bit

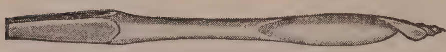


Fig. 28.—Half-twist or Screw Bit

Fig. 29.—Centre Bit

The shell bit has to be forced into the wood by continual pressure. If the hole is deep or in hardwood it is customary, after boring a little distance, to withdraw the bit whilst still turning in the same direction, so that some of the "core" is withdrawn. If it is attempted to bore a deep hole without withdrawing some of the core at intervals the bit will get very hot and the brace difficult to turn, there being also a possibility of boring an unsatisfactory hole.

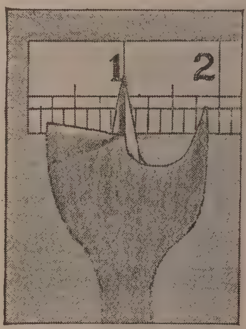


Fig. 30.—Obtaining Size of Centre Bit

Spoon Bit.—Fig. 26 shows this bit to be similar to the shell bit except that the cutting end is spoon-shaped. It is a little quicker in action than the ordinary

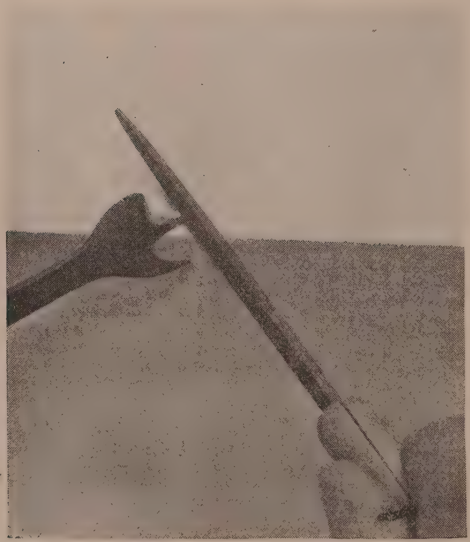


Fig. 31.—Sharpening Point of Centre Bit

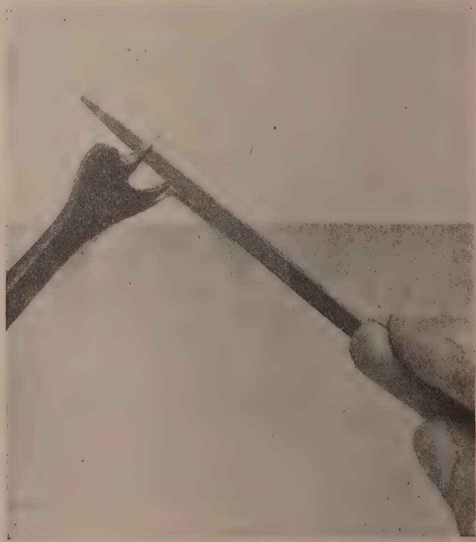


Fig. 32.—Sharpening Nicker of Centre Bit

shell bit, but the end is soon damaged by "running against" a nail.

Nose Bit.—This is another variety of shell bit (*see* Fig. 27) possessing the same merits and demerits. Both spoon and nose bits are useful for boring with the grain, and the shape of the end enables the core of the hole to be easily withdrawn.

Half-twist Bit.—This bit (Fig. 28) is often known as a "screw bit" because it is used in "boring for screws," for which it is particularly suited. It is self-propelling, and is therefore not fatiguing to use. As the bit starts at a point and gradually thickens in the shank it exerts a wedge-like action when boring, and care is therefore necessary to avoid splitting the wood.

Fig. 33.—Removing Burr on Nicker of Centre Bit

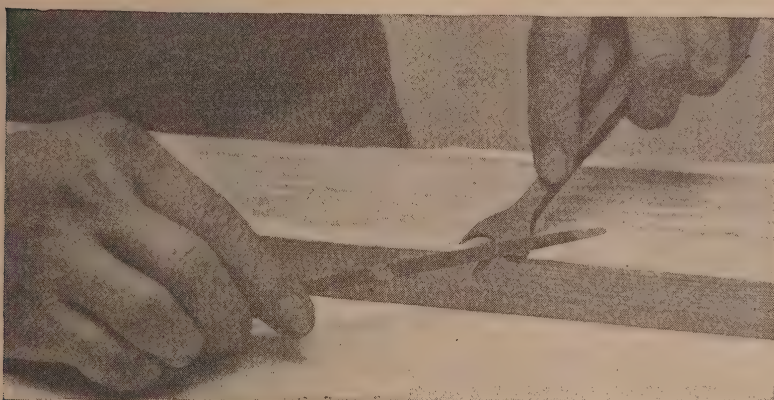


Fig. 35.—Filing Cutter of Centre Bit

Centre Bit.—This bit is of a distinct type from the preceding bits, its action in cutting a hole being quite different. A centre bit (Fig. 29) consists of three parts: the centre pin, which forms an axis or guide when cutting the hole; the outside point or "nicker," which marks the rim of the hole and cuts the wood fibres; the cutter or scoop, which removes the wood after the manner of a revolving chisel. The "size" of a centre bit is twice the distance from the centre pin to the nicker. For example, in Fig. 30 the distance from the centre of the bit to the nicker is $\frac{7}{8}$ in. and therefore the size of the bit is $1\frac{3}{4}$ in. The distance from the centre pin to the outside of the cutter should be *slightly less* than $\frac{7}{8}$ in. so that the side of the cutter will not rub or scar the side of the hole, thus giving a clean cut. The size of a centre bit should therefore be determined, as in Fig. 30, or a trial hole bored and measured.

As there are

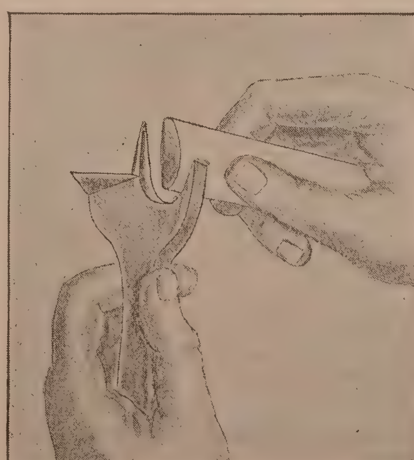


Fig. 34.—Using Finger Slip to Sharpen Centre Bit

three parts to a centre bit there must be three operations in sharpening. First

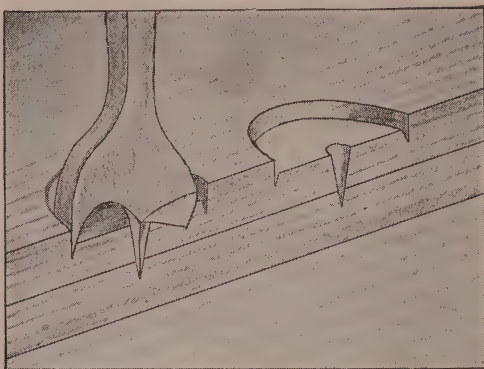


Fig. 36.—Boring with Centre Bit: First Operation, shown partly in section

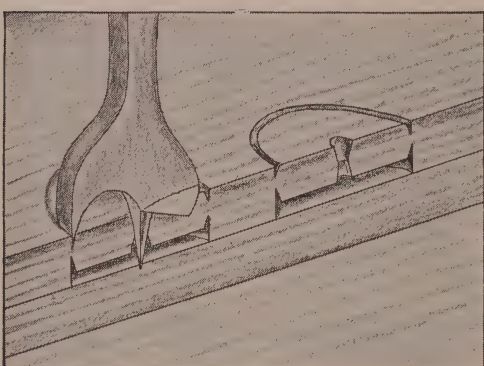


Fig. 37.—Boring with Centre Bit: Second Operation, shown partly in section

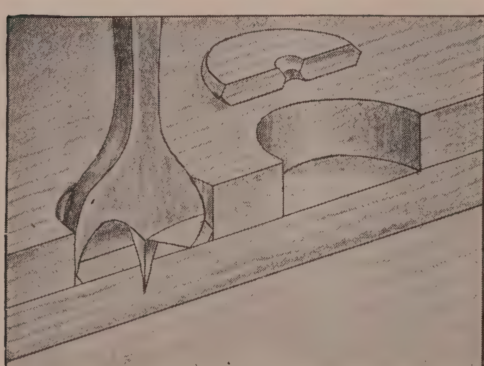


Fig. 38.—Boring with Centre Bit: Third Operation, shown partly in section

the point should be sharpened by filing, as in Fig. 31, if necessary. Fig. 32 shows how the nicker is filed—on the *inside*, not on the outside. If the latter were filed the size as well as the cutting properties of the bit would be spoiled. The nicker should also be sloping on the edge so as to cut easily. Sometimes the "burr" on the outside is carefully removed on the oilstone, as in Fig. 33, or the nicker finished with a "finger slip," as in Fig. 34, but these last two operations are hardly necessary except in very high-

Fig. 39.—Twist Bit: Jennings' Pattern

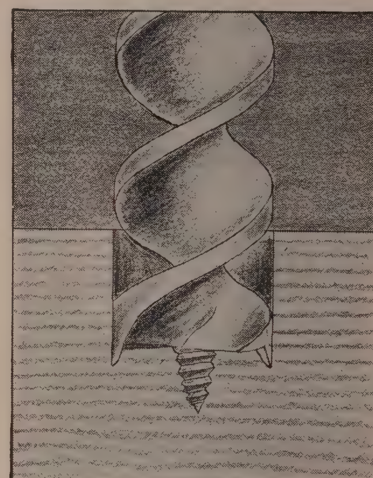


Fig. 40.—Cutting Action of Twist Bit

class work. Lastly, the cutter is filed, as in Fig. 35. The filing must be done on the top side of the cutter, otherwise the bit will not "bite" into the wood when in use.

A hole may be bored with a centre bit right through a piece of wood without splitting if a piece of wood is held against the wood where the bit comes through, as recommended when boring with the shell. It is usual, however, to bore from both sides of the wood. Figs. 36, 37 and 38 show a slight variation of the usual method of boring from both sides. Preferably the work is placed on or against a piece of waste wood, though this could be dispensed with. The hole is bored

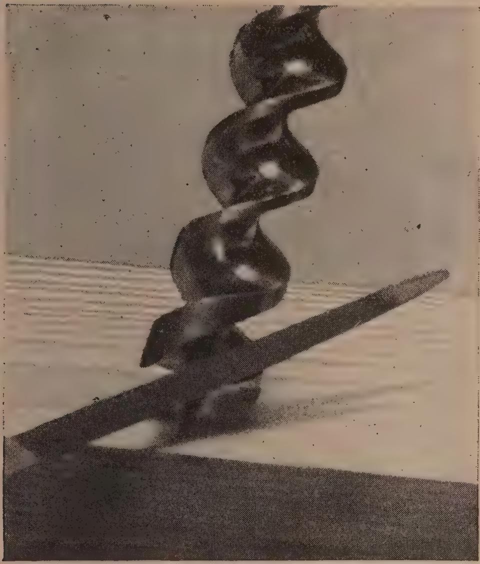


Fig. 41.—Filing Cutter of Twist Bit

Fig. 42.—Filing Nicker of Twist Bit

until the centre point projects a little through the back of the wood, as shown in Fig. 36. The work is then bored from the other side a little so that the nicker makes a circular cut, as indicated in Fig. 37. The work is turned back to its first position and the boring continued, when a circular piece should come out as shown. If the bit is sharp and held at right angles to the face of the work the hole will be true and smooth.

The ordinary type of centre bits have to be forced into the wood by constant pressure, but a special type with a screw centre point may be obtained. This is occasionally used for large holes, and as the screw end tends to pull the bit into the wood the work is made easier.

Twist Bits.—These bits have both a twisted point and a twisted shank. When the bit " gets a start " it forces its way into the wood. No pressure is usually equired on the head of the brace and it is only necessary to turn the crank. The worm point " eats its way " into the wood, this action being assisted by the spiral shank. The cutters at the end of the bit cut the wood after the manner of a centre bit—though this action varies a little with the type of twist bit used. Compare, for example, a Jennings' twist bit and a Gedge's twist bit. Twist bits are self-clearing, as the cuttings ascend the spiral shaft to the top of the hole.

In the Jennings' twist bit (Fig. 39) the end works on the principle of the centre bit, but has two nickers and two cutters—and, of course, a screw centre point. Fig. 40 is a sectional view of a piece of wood partly bored, showing the front edge of one cutter and the edges of the nickers. This twist bit is sharpened with a file

Fig. 43.—Twist Bit : Gedge's Pattern

Fig. 44.—Twist Drill Bit

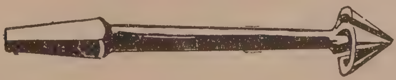


Fig. 45.—Wood Countersinks

after the manner of a centre bit; *see* Fig. 41, which illustrates how a cutter is sharpened, and Fig. 42, which shows a nicker being filed.

There are other twist bits of slightly varying design, but they usually belong to either of the two preceding classes.

A dowel bit is a short twist bit. Fig. 44 shows a twist drill bit that is very useful for boring hardwood in any direction of the grain without much fear of splitting.

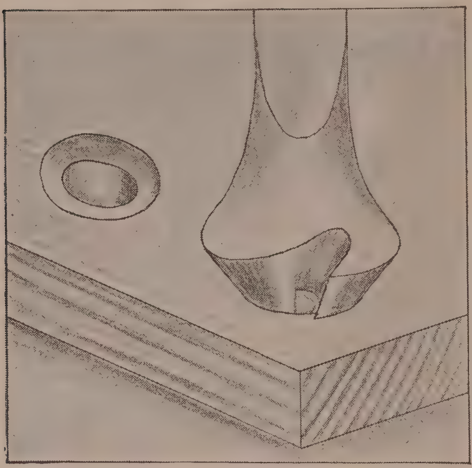


Fig. 46.—Using Wood Countersink

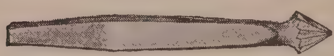


Fig. 47.—Countersink for Brass

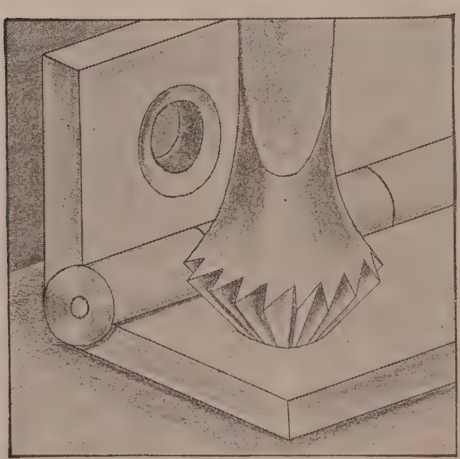


Fig. 48.—Using Countersink on Brass Hinge

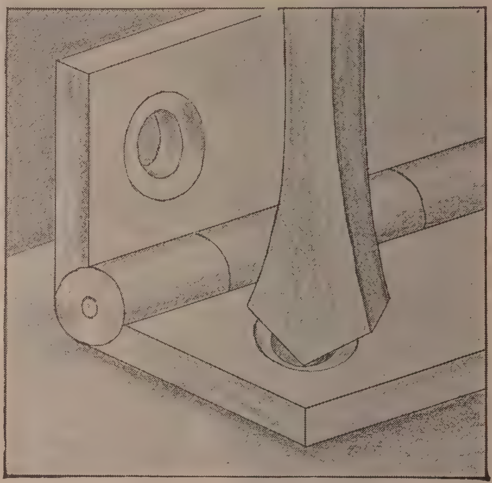


Fig. 50.—Using Iron Countersink

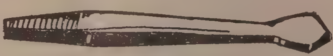


Fig. 49.—Iron Countersink

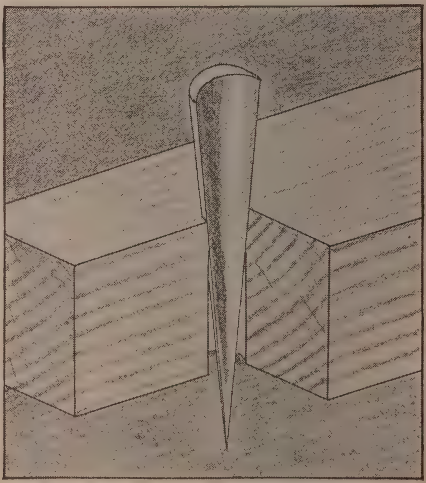


Fig. 51.—Using Wood Reamer

Gedge's bit (Fig. 43) is a twist bit very similar to the preceding but with a different shape of cutter end, which is formed by two curved wings. It is sharpened with a small round (rat-tail) file.

Countersinks.—These bits are of various types, and are used for counter-

sinking screw holes in wood or metal. Fig. 45 shows two types of countersinks for *wood*. The ordinary type is shown in use in Fig. 46. It will be seen that the bit has one cutter only. This bit should be sharpened with a rat-tail file. Fig. 47 represents a countersink for brass; it is shown in use on a brass hinge in Fig. 48, from which illustration it will be seen that the bit has a number of cutters; these should be sharpened, when required, with a small saw file. Very often this bit is used for countersinking timber, particularly hardwood, as it usually leaves a cleaner hole than the wood countersink.

A countersink for iron is shown in Fig. 49, and in use, countersinking the holes in an iron hinge, in Fig. 50. It is sharpened with a file or on the grindstone.

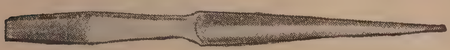


Fig. 52.—Wood Reamer

Fig. 55.—Screwdriver Bit

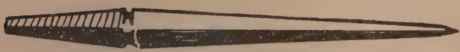


Fig. 53.—Iron Reamer

Fig. 56.—Forked Turn-screw Bit

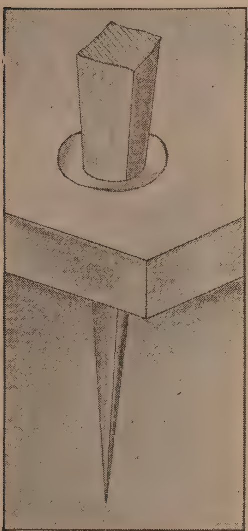


Fig. 54.—Using Iron Reamer

Fig. 57.—Expansion Bit (Clarke's Patent)

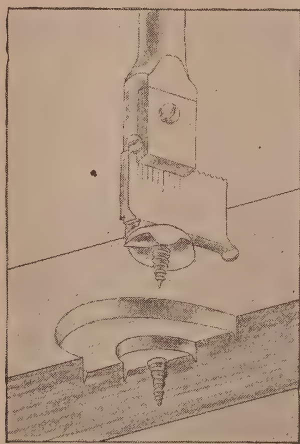


Fig. 58.—Boring with Steer's Screw Adjustment Expansion Bit. The Wood is shown in Section.

Fig. 59.—Forstner Bit

Reamers.—These are used for enlarging holes already made. There are three chief types. Fig. 52 shows a reamer for wood, which is after the manner of a tapering shell bit and should be sharp on the edges. Fig. 51 shows the wood reamer in use.

A metal reamer (Fig. 53) is like a long pyramid in shape and has four cutting corners. In Fig. 54 the end of the reamer is shown enlarging a screw hole in a metal hinge. This reamer though supposed to be specially for iron is also suitable for brass, etc.

A special reamer for brass, semi-circular in section and tapering in length like the two former types, is sometimes used. It is, however, not necessary, and the iron reamer will do the work equally well.

Screwdriver Bit.—This bit is shown in Fig. 55 and is very useful for driving screws, particularly if the screws are numerous or large in size. The chief difficulty when using the brace and screwdriver bit is not to turn the brace or screw but to keep the bit in the nick of the screw. It is better when dealing with tight screws to use the ratchet and turn the crank backwards and forwards through a small arc.

A forked screwdriver bit is shown at Fig. 56, and is used for tightening saw screws and other screws of the same kind, as already shown in the chapter on saws and sawing.

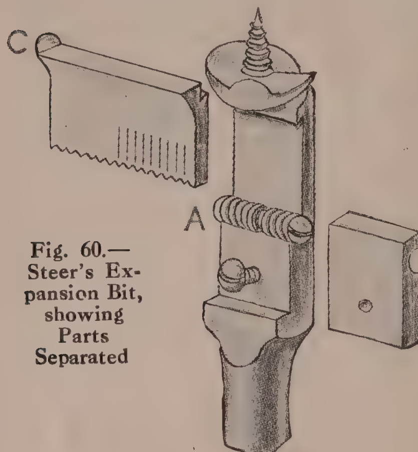


Fig. 60.—Steer's Expansion Bit, showing Parts Separated

Fig. 64.—Bit Gauge

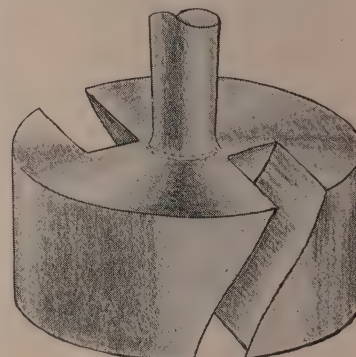


Fig. 61.—Enlarged View of Forstner Bit

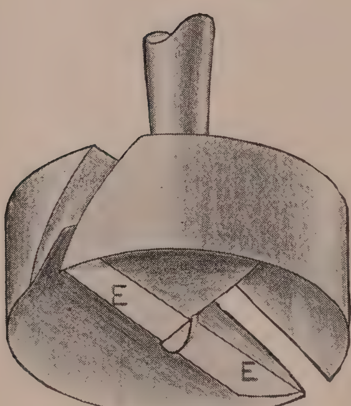


Fig. 62.—Forstner Bit, showing Cutting Edges

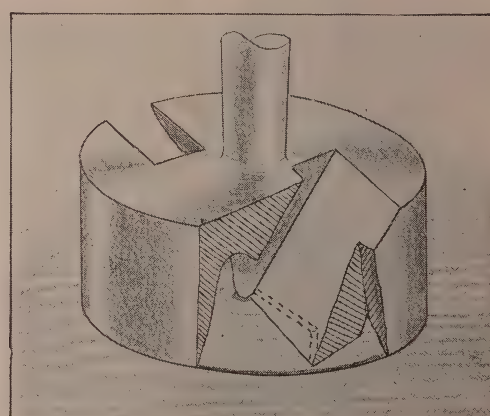


Fig. 63.—Sectional View of Forstner Bit, showing Cutting Action

Expansion Bits.—The ordinary type of expansion bit (Clarke's patent) is shown in Fig. 57. The principle is quite simple: an adjustable wing cutter slides in a groove; the projection of this cutter gives the radius of the hole, the cutter being fixed in any desired position by means of a screw. One expansion bit will cut holes within certain limits only, two useful sizes being a small one cutting holes between $\frac{1}{2}$ in. and $1\frac{1}{4}$ in. and a larger one boring from $\frac{7}{8}$ in. to 3 in.

In the screw-adjusting expansion bits (*see* Figs. 58 and 60), turning the side screw A with a screwdriver modifies the distance of the circular cutter C.

Forstner Bit.—This bit (Fig. 59), unlike other bits, is guided not by its centre but by its circular rim. It will bore any arc of a circle, and will bore in any direction regardless of grain or knots and leave a smooth surface. It is particularly useful for recessed work.

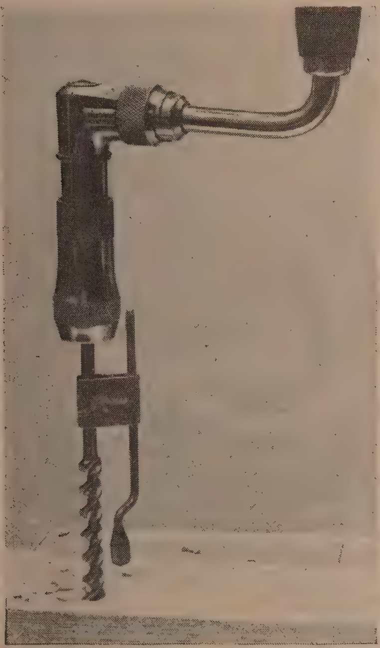


Fig. 65.—Using Bit Gauge

Fig. 66.—Dowel Sharpener

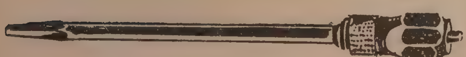


Fig. 67.—Extension Bit

A small three-cornered, or flat, file is used for sharpening it. Figs. 61 to 63 illustrate clearly the action of the bit; E indicates the two cutting edges.

Bit Gauges.—When boring holes, say for dowels, they have to be of a certain depth. The correct depth can be obtained in various ways. If there are not many holes the two following methods may be used: (1) count the number of turns of the brace to bore the first hole

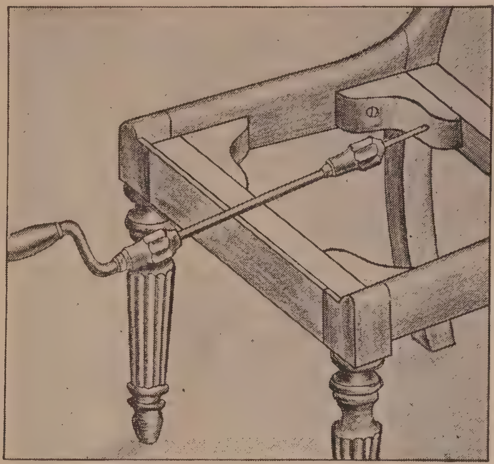


Fig. 68.—Using Extension Bit

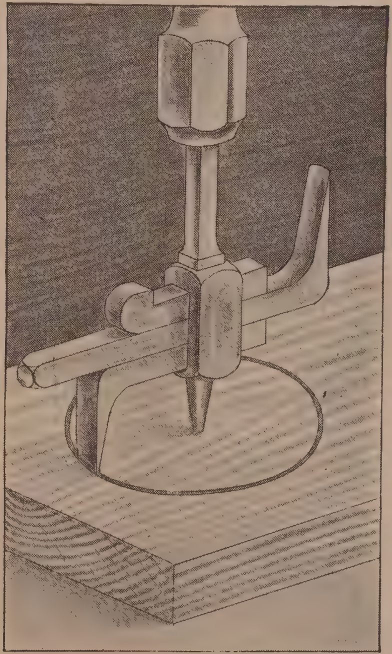


Fig. 69.—Disc Cutter in Use

of correct depth and give the other holes a similar number of turns; (2) mark the bit with chalk, a pencil or a file.

Fig. 64 shows a gauge (and enlarged

detail) for attaching to the side of a bit, and Fig. 65 shows the gauge in use. Bit gauges for countersinking are also used, so that the countersinking will accurately receive the head of the screw.

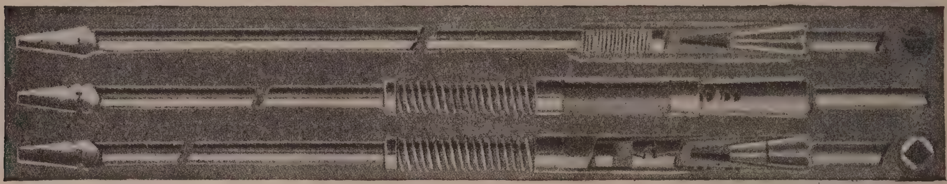


Fig. 70.—Extension Bits

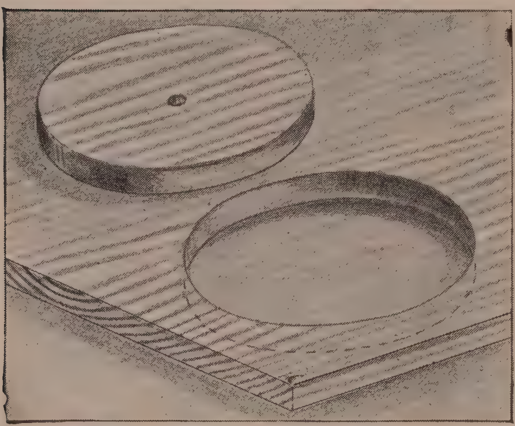


Fig. 71.—Circular Disc Cut Out

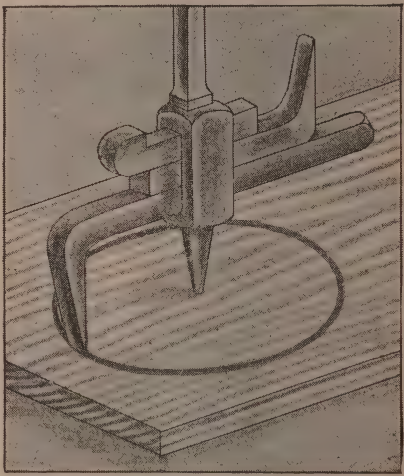


Fig. 72.—Cutting Circular Recess or Disc with Disc Cutter

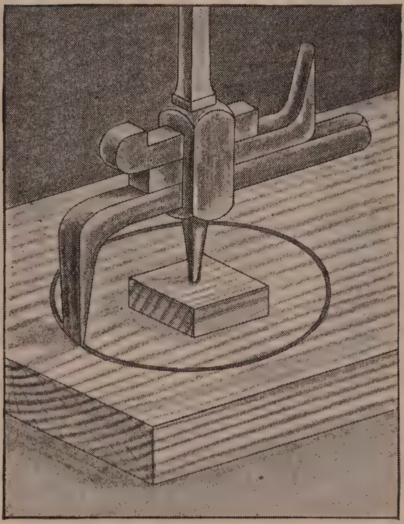


Fig. 73.—Method to Avoid Making Hole in Centre of Recess

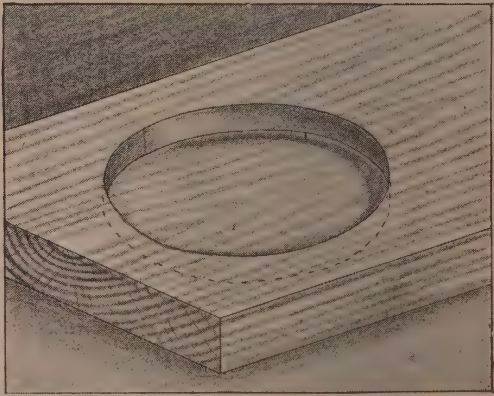


Fig. 74.—Circular Recess as Cut with Disc Cutter

Other Bits and Devices.—A bit for pointing the ends of dowels is shown in Fig. 66.

Figs. 67 and 70 show various patterns of extension bit holders. These will extend the brace bit, enabling it to be used for boring through walls, floors, etc., where the ordinary bit will not reach. Fig. 68 gives an example of their use.

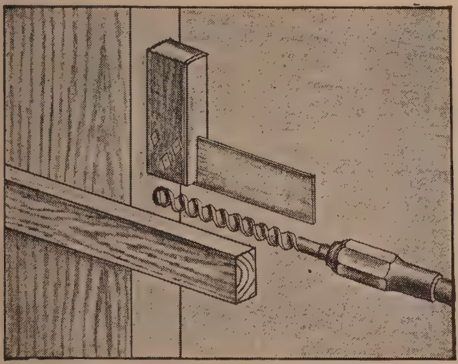


Fig. 75.—Boring at Right Angles to Edge

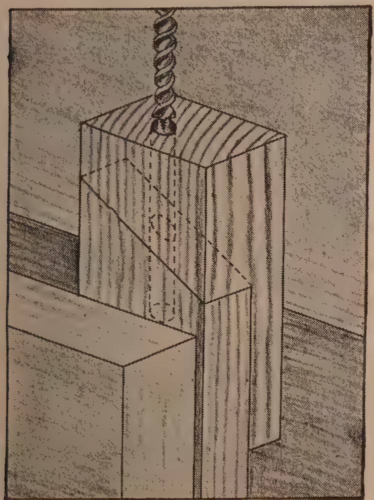


Fig. 76.—Boring Mitre

A disc cutter bit is often found useful for cutting small wheels and discs. It consists of a centre point and a sliding nicker which can be adjusted according to the size of disc required. Fig. 69 shows the cutter being used to cut a hole (or alternatively, a disc) from a thin board. Fig. 71 shows the finish of the operation. The disc cutter is also useful for cutting circular recesses that are too large for a centre bit. The circular side is first cut, as in Fig. 72, by chiselling. If it is desired to avoid a mark in the centre a piece of waste wood should be used, as in Fig. 73. The finished recess is shown at Fig. 74.

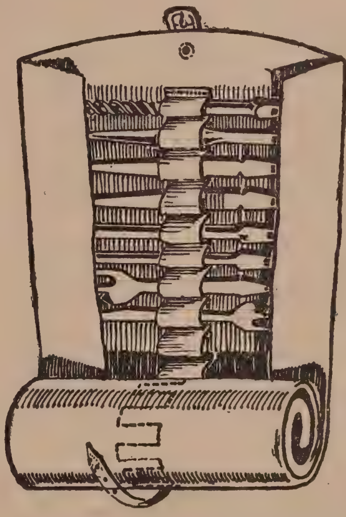


Fig. 77.—Case for Holding Bits

Boring at Right Angles to an Edge.—When boring for mortise locks and similar purposes care has to be exercised so that the bit goes in the right direction. This is best tested by a straightedge, as shown at Fig. 75. The bit must also fit the blade of a try-square as shown.

Boring at an Angle to a Mitre.—To bore accurately a hole at a mitre is somewhat difficult; but it can easily be done by a guide piece, as shown at Fig. 76.

A case or roll for holding bits is shown in Fig. 77. Some woodworkers prefer a case with longer pockets so that the bits cannot come in contact with, and damage, each other.

A Few Elementary Examples

COMBINED BOOK TROUGH AND STOOL

This chapter gives designs and descriptions of a few useful articles for the home. Though the articles are not elaborate the parts will have to be made carefully and accurately to ensure neat work.

The first example is a book trough as in Fig. 1. It will require one piece called A 1 ft. 7 in. by $9\frac{1}{4}$ in. and $\frac{7}{8}$ in. thick, two pieces B $12\frac{1}{2}$ in. by $7\frac{1}{4}$ in. and $\frac{7}{8}$ in. thick, one piece C 1 ft. 4 in. by $3\frac{3}{4}$ in. and $\frac{5}{8}$ in. thick, and one piece as last but $7\frac{1}{4}$ in. wide.

The first piece specified above forms the top shelf, and should be finished 1 ft. $6\frac{1}{2}$ in. by 9 in. by $\frac{3}{4}$ in. It will need two chases or housings $\frac{1}{4}$ in. deep cut into it exactly as shaded and figured in Fig. 4, and should also be chamfered all round on the underside as shown in section by Fig. 6, where a very small chamfer is shown at D, this giving a more durable edge than if this were simply a thin fillet.

For the uprights the two pieces B will be required. Each should be finished $12\frac{1}{4}$ in. by 7 in. by $\frac{3}{4}$ in., and worked as in Fig. 3. This shows them cut square at E, housed $\frac{3}{8}$ in. deep (Fig. 5) for the two sloping shelves at F, and pierced with a trefoil at G. The trefoil can be cut mainly with a brace and bit, and consists of a $1\frac{1}{4}$-in. sided equilateral triangle having a 1-in diameter circle struck from each of its points (*see* Fig. 7).

The sloping shelves forming the trough are at right angles to one another, and can be prepared from the two pieces C, the whole work being accurately and tightly fitted, glued up, and screwed or nailed.

A USEFUL SCULLERY FITMENT

The scullery fitment shown by Fig. 8 is easily constructed. The top projecting

Fig. 1.—Book Trough and Stool

rail acts as a rack for saucepan lids, the lower shelf as a draining rack for light articles, and a shelf for the accommodation of brushes, etc.

The materials required are 6 ft. of matchboarding and 4 ft. of 2-in by 1-in. planed deal. Wood $4\frac{1}{2}$ in. wide and $\frac{1}{2}$ in. thick can be used in place of the match-

boarding if desired. In fact, by altering the design to suit, any odd pieces of timber could be utilised.

Take the piece of deal in hand first, and from it cut two pieces 1 ft. 6 in. long. These form the sides. Cut the matchboarding into 2-ft. lengths, and saw one of the pieces down the centre. These two strips form the top and bottom rails, which must be half-dovetailed into the sides. Fig. 9 shows the position of the dovetails, half of the front rail and shelf being cut away for that purpose. This completes the frame. Take the piece of deal left over from the sides, cut two pieces 4 in. long from it, and shape as at A (Fig. 10). The recess in the top (which provides for the reception of the projecting rail) is $1\frac{1}{2}$ in. by $\frac{1}{2}$ in. These pieces are fastened to the frame, 3 in. from the top, with screws inserted from the back. Cut a rail $1\frac{1}{2}$ in. wide from one of the two remaining pieces of matchboarding, and nail or screw across the frame in the recesses. Cut two pieces from the other portion of matchboarding $5\frac{1}{2}$ in. long and $2\frac{1}{2}$ in. wide, and let these into the sides $1\frac{1}{4}$ in. from the bottom, and slope slightly upwards about 1 in. in 6 in. To these supports three $1\frac{1}{2}$ in. rails, which can be cut from the remaining piece of matchboarding, should be nailed across, as shown in Figs. 9 and 10. The beaded edge of the matchboarding can be left on, and used with effect, as shown at B (Figs. 9 and 10).

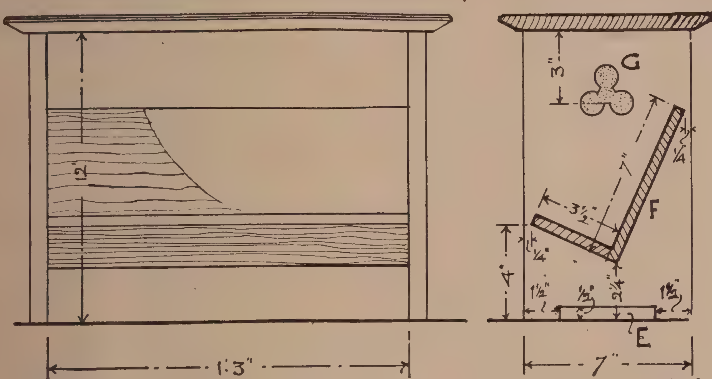


Fig. 2. Figs. 2 and 3.—Two Elevations of Book Trough Fig. 3.

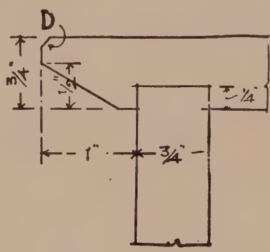


Fig. 6.—Detail of Chamfered Top

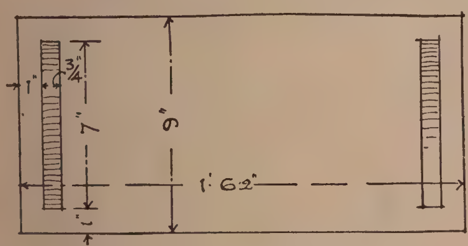


Fig. 4.—Plan of Underside of Top

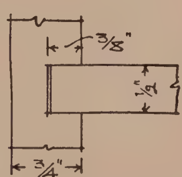


Fig. 5.—Method of Fitting Shelf

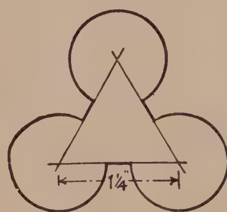


Fig. 7.—Method of Setting Out Trefoil

It is recommended that the rack be left plain, though it could be varnished if thought at all desirable.

BOOT AND SHOE RACK

A rack for boots, shoes, and slippers, which would be useful in almost any house is shown by Figs. 11 to 14. It can be

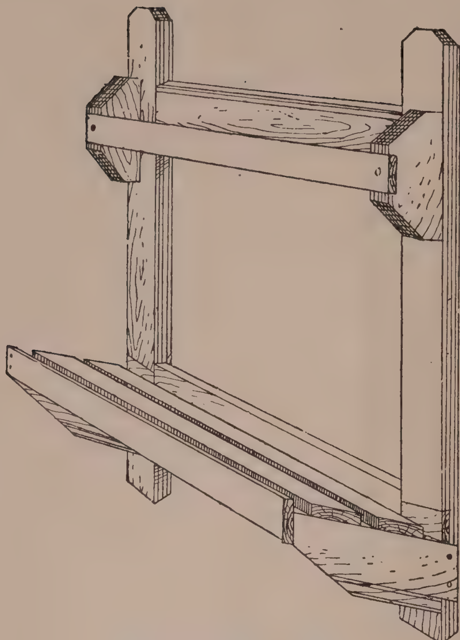


Fig. 8.—Scullery Fitment

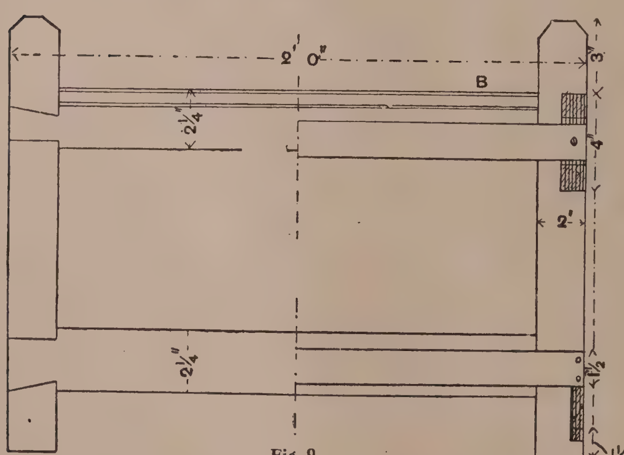


Fig. 9.

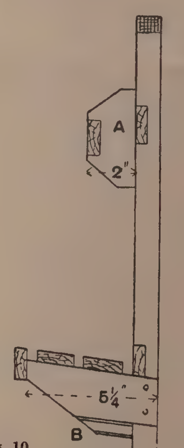


Fig. 10.

Figs. 9 and 10.—Front and End Elevations of Scullery Fitment

made of ¾-in. yellow pine or sound red deal, and requires two ends, 2 ft. 9 in. by 11 in. by ¾ in.; one top, 4 ft. by 12 in. by ¾ in.; three braces, 3 ft. 6 in. by 3 in. by ½ in.; six rails for shelves, 3 ft. 7 in. by 2 in. by 1 in.; and one thickessing fillet to be mitred round the lower edge of the top, 6 ft. by 1¼ in. by ⅞ in.

First prepare the rails. Plane them square, and take off the sharp corners to form a slight chamfer. Shoulder and tenon each end ready for the ends, which can then be prepared with the mortises, and cut out the bottoms, as shown in Figs. 12 and 13. Space them out as shown, the two top rails for children's boots and slippers being closer together than the others. When the mortises are cut, gently drive on the ends and wedge the rail tenons. Across the back screw three braces A (Figs. 11 and 13), round off the back edges, as at B in Fig. 14, and then screw on the top from the underside, the ends being gouged for the screws.

At the front, immediately below the top, place a rod of wood or $\frac{3}{16}$-in. diameter iron suspended by brass hooks, as at C in Fig. 13, on which to fix a curtain to cover the whole.

The thicknessing fillet along the top can next be fixed, and the rack is then ready for painting, or staining and varnishing. Rails are preferable to solid shelves, as they admit of a free current of air to dry the soles of the boots.

PHOTOGRAPH STAND

The miniature easel, or stand for photographs (Fig. 15) has quite an attractive

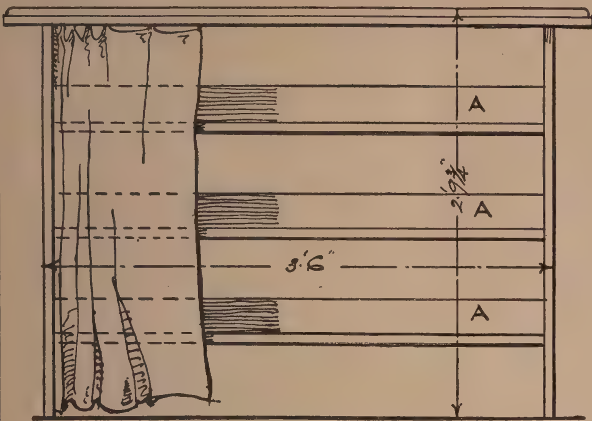


Fig. 11.

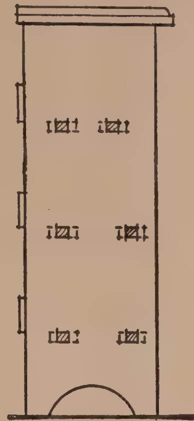


Fig. 12.

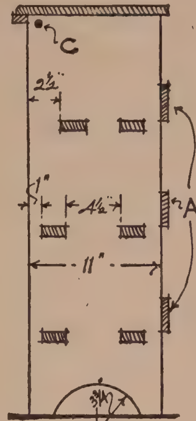


Fig. 13.

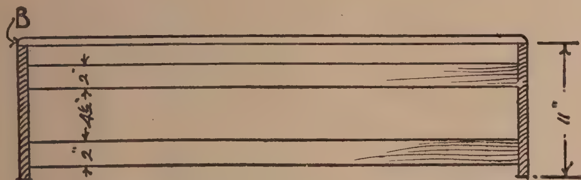


Fig. 14.—Plan of Boot and Shoe Rack (Top Removed)

Figs. 11 to 13.—Front and End Elevations and Vertical Section of Boot and Shoe Rack


Fig. 15.—Photograph Easel-stand

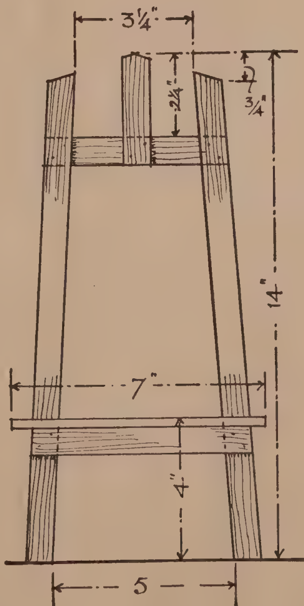


Fig. 16.

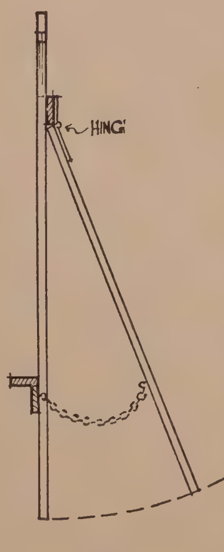


Fig. 17.

Figs. 16 and 17.—Front and Side Elevations of Photograph Easel-stand

appearance, and can be used in widely different sizes. It presents an opportunity for utilising odd pieces and scraps for which it might otherwise be difficult to find a use, and the sizes given in Figs. 16 and 17 require about 5-ft. run of stripwood of about, say, $\frac{3}{4}$ in. or $\frac{5}{8}$ in. by $\frac{3}{16}$ in. or other convenient dimensions.

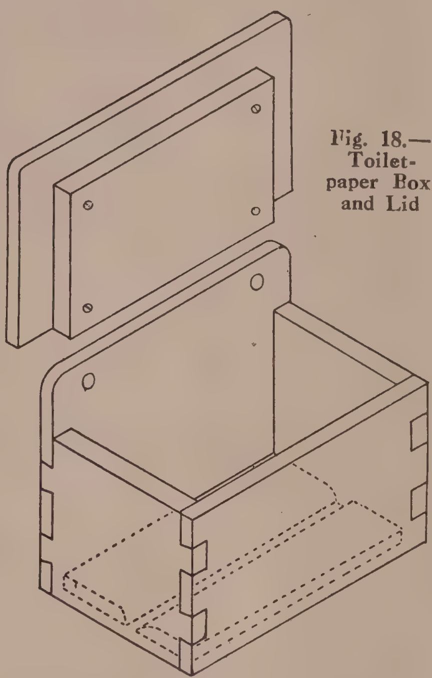


Fig. 18.—Toilet-paper Box and Lid

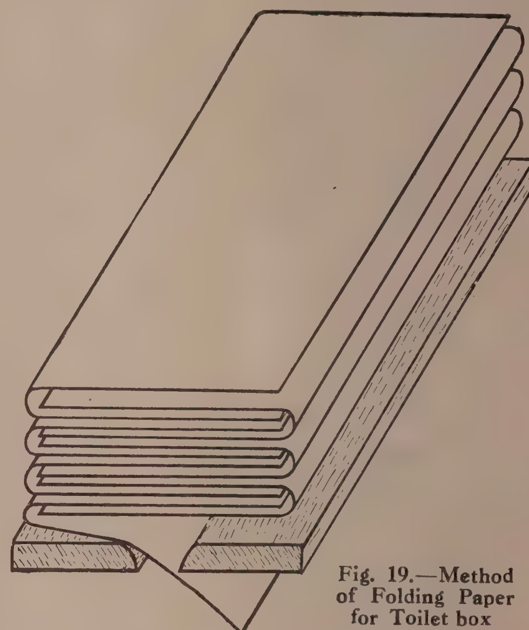


Fig. 19.—Method of Folding Paper for Toilet box

Fine wire brads filed off smooth will give suitable fixing; or round-headed brass screws might be employed. The support should be hinged rather than rigid, and the extent of its opening limited by a small length of chain or ribbon at the bottom.

A BOX FOR TOILET-PAPER

A box in which home-cut toilet-paper may be kept tidily and conveniently is shown by Fig. 18. A pile of paper having been cut to size, each piece is folded in half and the pieces interweaved so that the one half of a folded piece of paper is between the folds of the next higher piece, and the other half between the folds of the next lower piece. Fig. 19 shows several pieces as they lie in the box. It will be seen that there is a slot in the bottom of the box, running across the centre lengthwise. A portion of the bottom piece of paper is passed through this slot and hangs down underneath the box. When this piece is pulled out it brings with it a portion of the next piece, ready to be pulled out in its turn, and so on until the contents of the box is exhausted.

Suitable outside dimensions of the box are as follows: Sides, 4 in. high by $4\frac{1}{2}$ in. long; front, 4 in. high by 7 in. long; back, $5\frac{1}{2}$ in. high by 7 in. long. The thickness of the sides may be $\frac{1}{2}$ in.; the front and back $\frac{3}{8}$ in. The bottom is $\frac{3}{8}$ in. thick

and is in two pieces, separated in the centre lengthwise by about ½ in. to form the slot. The pieces may be simply screwed together, or jointed and glued as shown. The lid consists of two pieces of wood, screwed together, the under-piece fitting down into the box, and the top piece projecting over the sides and front of the box about ½ in. The under-piece may be ½ in. thick, the top piece ⅜ in. In the top portion of the back two holes are bored, as shown, for hanging the box on nails or hooks driven into the wall. When finished the box may be stained and varnished.

A box of the size described will take paper 5¾ in. by 7 in. When cutting the paper, time will be saved by arranging a pile of paper, marking out the size on the top piece, and cutting through the lot with a sharp knife, using a straight-edge as a guide.

MINCING OR CHOPPING BOX-BLOCK

A box-block, as illustrated by Fig. 20, on which meat, vegetables, etc., can be minced with an upright chopper, can be made with a piece of ash 1 ft. 1½ in. by 9⅞ in. by 2 in. (marked A in Figs. 22 and 23), two ends of deal 11 in. by 6 in. by ½ in. (B in Figs. 21, 22, 23), one side of deal 1 ft. 3 in. by 6 in. by ½ in. (C, Fig. 23), and one side of birch 1 ft. 2 in. by 4 in. by ⅜ in. (D, Figs. 20 and 23).

Plane the block to thickness, and square the sides and ends. The fence above the block, 1 ft. 1¼ in. long by 9¾ in. wide, inside measurement, should first be "cogged" together, as at E in Fig. 3.

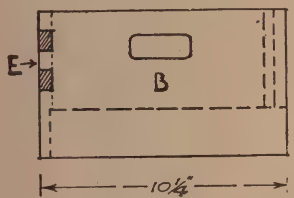


Fig. 21.

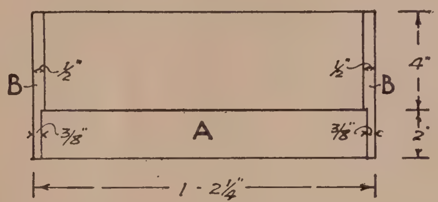


Fig. 22.

Figs. 21, 22 and 23.—Front and End Elevations and Plan of Chopping Box-block

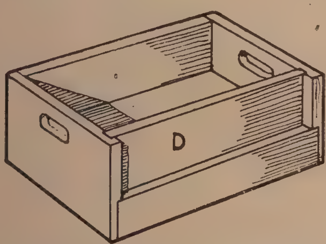


Fig. 20.—Mincing or Chopping Box-block

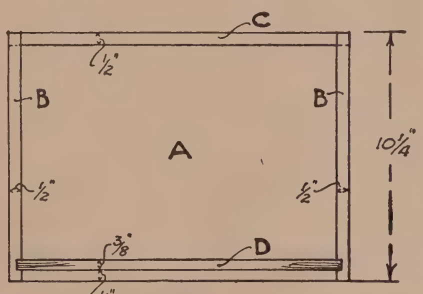


Fig. 23.

Then separate the three pieces and rebate them to a depth of ⅛ in., so as to fit over the block. This forms a close joint, and prevents the minced stuff working down between the block and the fence. The two end pieces are grooved for a loose side of ⅜-in. birch (D); this lifts out to enable the minced contents to be readily removed from the block. Pierced holes to facilitate lifting are required in the ends as shown.

The inside of the box-block should be glasspapered clean, and the outside sized and varnished, when it will be ready for use.

LETTER BOX

The letter box, suitable for fitting to a front street door, shown by Fig. 24, is fairly simple to make, and its usefulness will be quite apparent. The box is made entirely of wood; hard or softwood may be used, but hardwood will, of course, be preferable. A slot through which the letters may pass into the box is cut in the door rail; the slot is 7 in. long by 1¾ in. wide. A small door having a glass panel is fitted at the bottom of the box, by means of which the letters are removed from the box. In making the box, wood ½ in. thick should be used. The sides are cut so that when finished they are to the dimensions given in Fig. 25. The top and bottom are 8½ in. long and should be wide enough to overhang the sides ¼ in. at the front. The top and bottom are dovetail-grooved to the ends of the sides. Joints as shown by Fig. 26 are used, and the width over the sides is 8 in. The back of the box is in two portions, as shown in Fig. 25, and it is rebated into the back edge of the sides, as shown by Fig. 27. The front of the box is grooved into the sides, joints as shown by Fig. 28 being used. The front of the box finishes 5 in. up from the bottom to allow for the door. These portions of the box should be cleaned up, and finally fixed together with glue and nails. In fixing together, first fix the front into the sides, then the top and bottom, and finally the back.

The door of the box is framed together, as shown by Fig. 29. The framework is 1 in. wide by ½ in. thick, and is put together with mortise-and-tenon joints as shown. The framework is beaded and rebated, and the glass is held in position in the rebate with small fillet pieces, as shown in Fig. 29. The door is hung with a pair of small butt hinges, and should be fitted with a small mortise lock and key. Small fillet pieces are fitted to the interior of the box to act as stops for the door, as shown in Fig. 25. Two small metal plates are fixed to the top and bottom of the box, as shown in Figs. 24 and 25, and the box is fixed to the door with screws, which pass through these plates.

The interior of the box should remain in the natural state of the wood; but the exterior should be polished or painted.

The letter-box plate and flap may be of copper, about 20 B.W.G. being a suitable thickness. The plate is cut to the dimensions given in Fig. 30, and is shaped as shown by Figs. 30 and 31. A small bead is worked round the edges, and four screw holes are provided in the plate. The opening in the plate for the flap is 6 in. long by 1½ in. wide, and the flap should be slightly larger than the opening in the plate. The plate and flap are hinged together, as shown in Figs. 30 and 32. The hinge pin is ⅛ in. in diameter, and the edges of both the plate and flap are curled round a piece of wire of this dimension. The wire is then withdrawn, and the hinge is jointed up in the usual manner by cutting out the portions which are not required, as shown in Fig. 32. The letters should then be worked on the flap, this, of course, being done on a pitch block. The hinge pin is then fitted, and finally the plate and flap are cleaned up and lacquered. The plate is fixed to the door with four round-head screws.

MAKING IRONING BOARDS

Skirt boards are made of various sizes, but a most suitable one is 5 ft. long by 1 ft. 5 in. wide at one end and 9 in. at the other.

In making a board of this kind, an important defect to guard against is the tendency which the board has to warp and cast after being used for some time. Fig. 33 shows the side of a board with cross ends which have cross-tongued joints, and also a dovetail key to prevent warping or casting.

This is an advantage, as the board is kept level and fair. Fig. 34 is a plan. The board should be covered with a piece of white felt or flannel, which can be fixed by tacking the edges, as shown in Fig. 35. These boards, like ironing tables, are covered with blankets and sheets.

Polishing boards are made in the same way as skirt boards. and are of uniform

size and width. A suitable size is 1 ft. 6 in. long and 1 ft. wide. These boards are best made of hardwood, on account of the extra pressure given when the polishing iron is used. When the board is only used for this work there is no need to cover it. Fig. 36 shows a polishing board with cross ends made of birch.

The joints are formed with cross-tongues, as in the skirt board.

Boards are made for the double purpose of ironing and polishing. In this case the covered side is used for the first-mentioned work, and the back of the board is taken for the polishing.

A sleeve board is a tapered board about

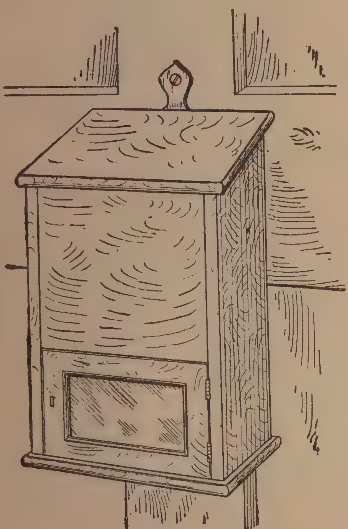


Fig. 24.—Letter Box Secured to Door

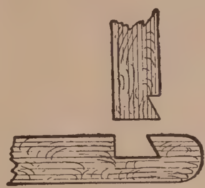


Fig. 26.—Joint Between Sides and Bottom

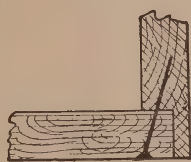


Fig. 27.—Joint Between Bottom and Back

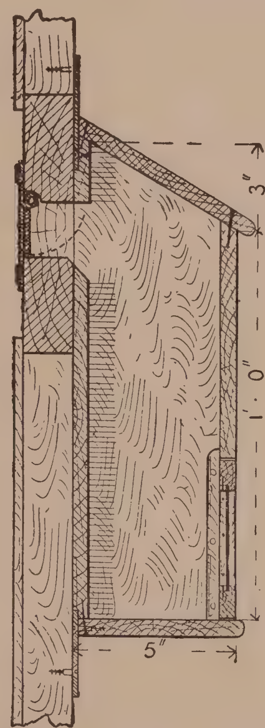


Fig. 25.—Vertical Section of Letter Box

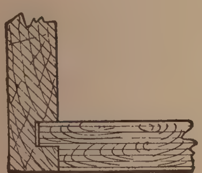


Fig. 28.—Joint Between Sides and Back

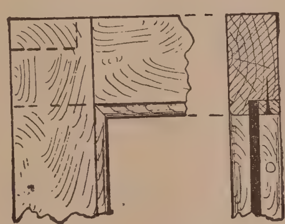


Fig. 29.—Details of Door Framing

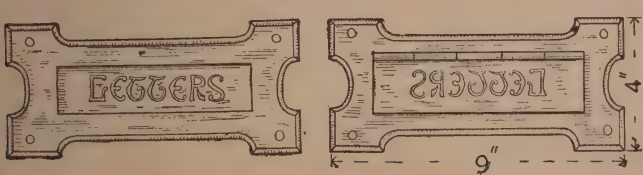


Fig. 31. Fig. 30.

Figs. 30 and 31.—Front and Back Elevations of Letter Plate

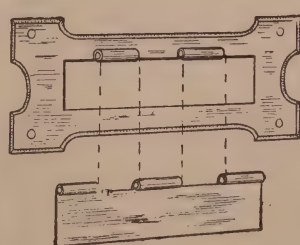


Fig. 32.—Details of Letter Plate and Flap

1 ft. 6 in. long and 4 in. to 5 in. wide at one end, decreasing to about 2 in. towards the other end. The tapered board can either be fitted to an upright stand or on a bracketed stand, as shown in Figs. 37 and 38. The top of the board should be covered to provide a soft surface for ironing. It is used, as its name indicates, for the ironing of sleeves of various sizes and shapes, especially for the fuller parts that cannot be made to lie flat on the table. The usefulness of the sleeve board depends on the make; one with a strong bracketed stand of the size given is very useful.

In making a sleeve board, as in Fig. 39 yellow pine should be used. Five pieces are required, the sole piece 1 ft. 4 in. by 6 in., shaped as in Fig. 38, the bracket 9 in. by 6 in., the ironing board 1 ft. 9 in. by 6 in., and the two vertical straps $7\frac{1}{2}$ in. by 2 in. by $\frac{5}{8}$ in. In jointing together the various parts, the vertical straps should be dovetailed to the back end of the sole piece and the ironing board, with a sufficient space apart to allow the bracket to pass in between them. The ironing board and sole piece should then be well screwed to the edges of the bracket. The top of this board should also be covered with white felt or flannel.

Fig. 33.

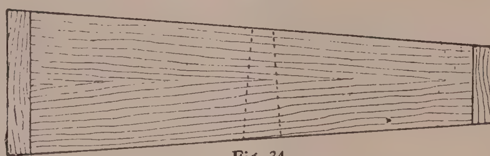


Fig. 34.

Figs. 33 and 34.—Elevation and Plan of Skirt Board

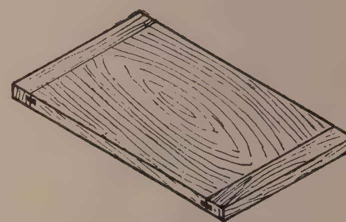


Fig. 36.—Polishing Board

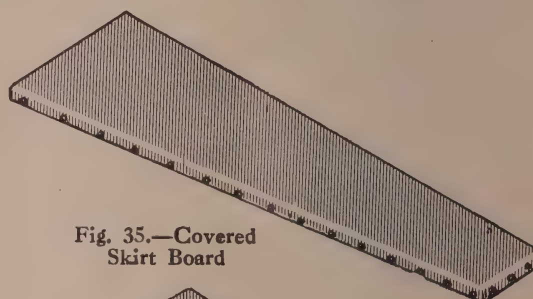


Fig. 35.—Covered Skirt Board

Fig. 37.

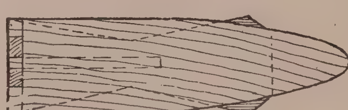


Fig. 38.

Figs. 37 and 38.—Elevation and Plan of Sleeve Board

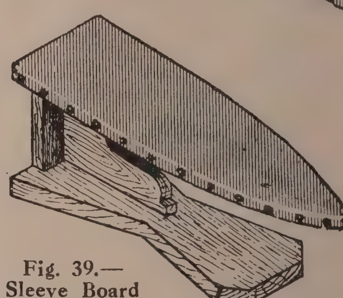


Fig. 39.—Sleeve Board

A NEWSPAPER RACK

The handy newspaper rack shown complete by Fig. 40 will look well if made of

oak, American walnut, or satin walnut. Fig. 41 shows the joint of the uprights into the horizontal bearers, and Fig. 42 the hidden housing for receiving the slats to form the floor.

The three frames of bars and slats A, B and C should be made separately, according to the finished measurements given. The top and bottom bars and the two uprights should be joined together with mortise-and-tenon joints, and the slats (five in number, $\frac{1}{2}$ in. by $\frac{1}{4}$ in.) should be let in the top and bottom rails for $\frac{1}{4}$ in.

Fig. 42 shows how the stopped housing joint L is made for the four slats, 6 in. by $\frac{1}{2}$ in. by $\frac{1}{4}$ in., forming the floor. These bearers should be secured by means of small screws run into the bottom rail. The whole should be polished, and a handle (*see* Fig. 40) attached to the central division.

HINGED TABLE-FLAP

A side-table hinged to fold flat against a wall when not required is often very

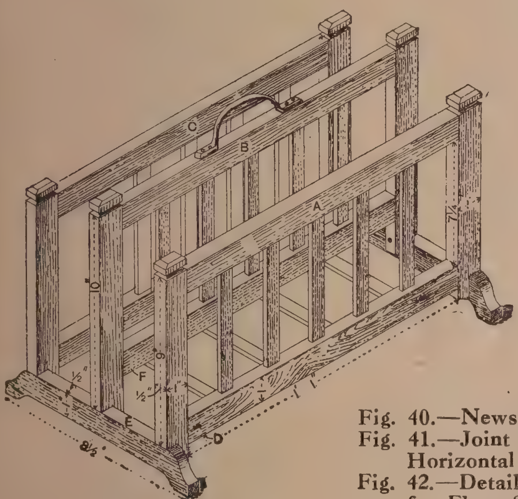


Fig. 40.

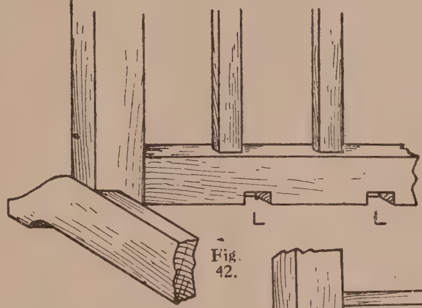


Fig. 42.

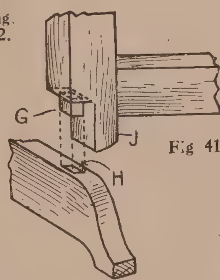


Fig 41.

Fig. 40.—Newspaper Rack
Fig. 41.—Joint of Upright into Horizontal Bearer
Fig. 42.—Detail of Outer Bars for Floor Slats

The central division is 1 in. higher than the two outside frames, as it gives the rack a better appearance. The lower bar should be so arranged that the lower edge D should be $\frac{1}{4}$ in. lower than the upper edge of the bearers E, so as to allow for the slats which will form the bottom coming on a level with the edge E. The lower bar F of the central division should be 1 in. higher than the two outer frames, so as to clear the floor slats.

Fig. 41 shows how to make a strong and neat joint to support the uprights. A pin G, cut as shown, is let into a mortise H, while a support J comes inside the horizontal bearers, and is fastened to the same with a screw as shown at K.

useful in kitchens and elsewhere, and can be made very efficiently by following the instructions here given.

The first consideration—and a very important one—is the fixing of the brackets to the wall surface. If this happens to be boarded the matter is simplified; but in most cases when plastered brickwork occurs, holes must be made and very tightly filled with small wooden plugs, to which the work can be nailed or screwed. In the event of the wall proving to have lath and plaster or wooden uprights (or "studding"), the latter must be located by sounding and a few trials with a small bradawl, and the work spaced out in such a way that it can be fixed to them.

To work in strict accordance with the illustrations, fix to the wall in the desired position three lengths of $2\frac{1}{2}$-in. by 1-in. deal, as at C and D in Fig. 50, the first two being 1 ft. $6\frac{3}{4}$ in. long and 2 ft. $4\frac{1}{2}$ in. apart. For a first-class job they can be halved to the horizontal piece D and chamfered on the exposed edges, although these points are not essential. Next very securely screw on a ledge, as at E in Figs.

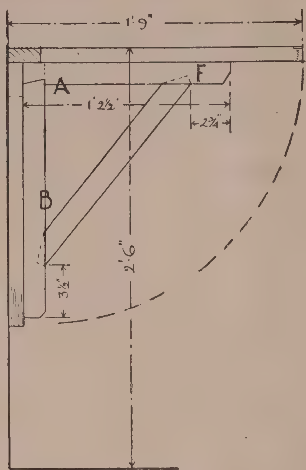


Fig. 44.—Side View of Hinged Table Flap

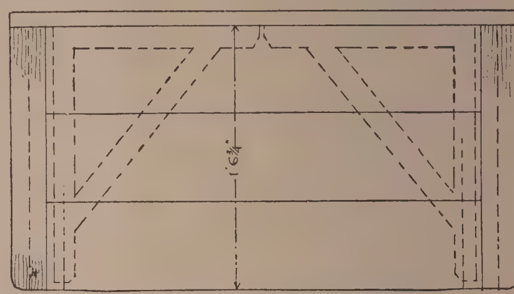


Fig. 45.—Front View of Hinged Table Flap

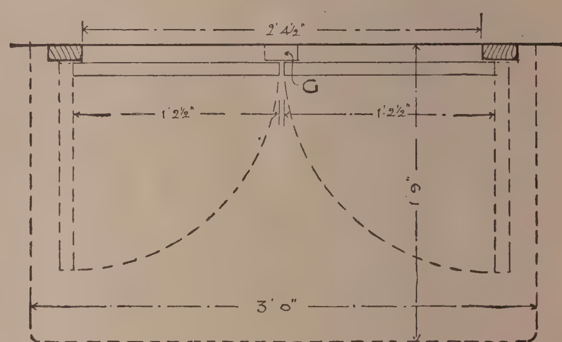


Fig. 46.—Plan of Hinged Table Flap

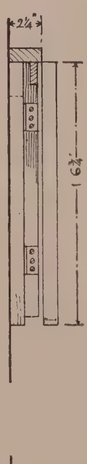


Fig. 43.—Side View, showing Flap Down

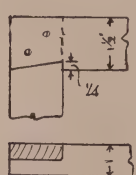


Fig. 47.—Detail of Joint at A (Fig. 44)

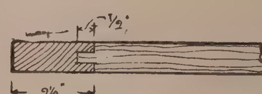


Fig. 49.—Section through Edge of Table

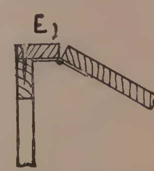


Fig. 51.—Section showing Hinging

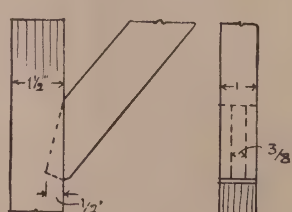


Fig. 48.—Details of Joint at B (Fig. 44)

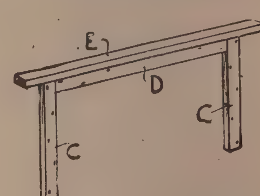


Fig. 50.—Bearers Fixed to Wall

50 and 51, $2\frac{1}{4}$ in. by 1 in. and 3 ft. long. This is also shown in Figs. 43 and 44, the latter giving a comprehensive view of one of the two "gallows-brackets" required. These are built up of about $1\frac{1}{2}$-in. by 1-in. stuff, dovetail-halved at A, and angle-tenoned at B and F in accordance with Figs. 47 and 48. When ready they should be hinged to the uprights in Fig. 50 in the manner shown by Figs. 45 and 46, the former showing how they just clear one another when folded back, and the latter a small stop on the wall at G to avoid any forcing of their hinges. They should just work easily under the small top ledge.

Dealing next with the table-top itself, this measures 3 ft. by 1 ft. $6\frac{3}{4}$ in. by 1 in. and has its two outer corners rounded. It is intended to be composed of three widths, cross-tongued together and "clamped" at the ends with pieces $2\frac{1}{2}$ in. wide, as in Fig. 49. Observe that when in use the join between the boarding and the clamp comes centrally over the bracket. If it did not receive this support it would be as well to continue the tongue (seen in Fig. 49) right through the clamp in two places, as tenons about 3 in. wide. Alternatively, for an inferior job, the flap could be composed of boarding on "ledges" across each end, these being only 2 in. wide in order to clear the brackets, unless the flap is increased a little in length to suit them. In each case the flap should be hinged from the underside, as explained by Fig. 51, and if of the clamped variety should have two small stops, against which the brackets would strike when opened to the full right angles. Some workers may find it more convenient to hinge the flap and ledge together before the latter is screwed finally in position; but it may be found necessary to take a little out of the tops of the brackets in order to clear the hinges.

The following is a list of the material required: Bearers, $2\frac{1}{2}$ in. by 1 in. 5-ft. 6-in run (6 ft. if halved at angles); brackets, $1\frac{1}{2}$ in. by 1 in., 8-ft. 6-in. run; ledge, $2\frac{1}{4}$ in. by 1 in., 3-ft. 3-in. run, flap, $6\frac{1}{2}$ in. by 1 in., 8-ft. 3-in. run; $2\frac{1}{2}$ in. by 1 in., 3-ft. 3-in. run; 1-in. oak cross-tongue, 5-ft. 6-in. run.

Box and Packing Case Construction

THE standard deals from which the spruce boards of which packing cases are made run 7 in., 9 in., and 11 in. in width by $2\frac{1}{2}$ in. and 3 in. in thickness. A 3-in. deal sawn into three planks by two saw-cuts makes 1-in. material. A one-cut $2\frac{1}{2}$-in. deal makes $1\frac{1}{4}$-in. material, while $\frac{3}{4}$-in. material is made by three cuts in a 3-in. deal. Thus the nominal thickness is always scant by about half the thickness of the saw, a 1-in. board being actually about $\frac{7}{8}$ in.

The case-maker is bound to charge for timber consumed, and if this cuts to waste the customer pays. It is therefore best that the latter receives the advantage of the extra inch or two removed. It usually makes for better packing or the inclusion of more goods without extra charge. The lengths of deals vary considerably; but if any quantity of cases are required of similar dimensions, it is often possible to arrange with the case-maker as to economical length. The price received for firewood in the shape of short ends does not compensate for their unnecessary manufacture.

Taking the usual widths, 7 in., 9 in., and 11 in., and remembering that width and depth of the case is alone considered for the moment. By assembly of boards in three widths without cutting the following dimensions are possible: 7 in., 9 in., 11 in., 14 in., 16 in., 18 in., 20 in., 21 in., 23 in., 27 in., 28 in., 29 in., 30 in., 32 in., 33 in., 34 in., 36 in., 38 in., 40 in., 42 in., 35 in., 37 in., 39 in., 41 in., 43 in., 39 in., 45 in., 47 in., 51 in., and 55 in. It will be seen that there is less exact choice in the smaller dimensions than in the larger. Anyone interested can follow out the permutations and combinations open to the integers 7, 9, 11 throughout the entire series possible to cases. Twelve feet and 14 ft. are usual lengths, and aliquot or fractional division of the normal lengths is desirable. If, for instance, the length of the case is 5 ft., it is obvious that 12-ft. boards are not an economy. Short ends 2 ft. or under are of little, if any, use except as firewood.

It must be remembered that planking width for the top and bottom measures are external. Internal depth and plank width are equal, and the length of ends is the internal size of the case. The total length of the case is, of course, external measurement, and the ends themselves are invariably thicker than the rest of the planking. When permitting the normal widths these facts must be borne in mind. Also that battens add to superficial measurement.

By rational consideration of the limitations set by his material to the case-maker, in very few instances is it necessary to cause serious wastage, for which it must be remembered the customer has to pay. If some attention be given to the subject it will frequently be found that an extra

couple of inches may be added to accommodate standard planks at no extra cost. Such addition is not detrimental to packing—on the contrary, it is advantageous; it allows the use of more wood-wool or other packing material, or the enclosure of extra goods.

Take an instance of fifty cases each 7 ft. 6 in. long, which have to be made up from 12-ft. boards. It is obvious that to utilise the cut portions the case-maker has to wait for a 4-ft. 6-in. order. If he utilises them for a 3-ft. 9-in. order there is a wastage (less firewood value) of 25 super ft. His customers unquestionably have to pay for this if he remains solvent.

The matter receives more attention when quantities of the same size case are dealt with, since by adjustment of dimensions the cost can be materially reduced. At all events, it pays to consult the case-maker before fixing the dimensions, if a large sum be involved. The basis on which cases are charged is that of superficial area. This differs considerably from the cube feet contained. The following figure show this clearly :—

Dimensions of case in feet (Internal).	*Cube feet contained (Internal).*	*Total superficial feet neglecting board thickness and battens.*
$4 \times 4 \times 4$	64	96
$3 \times 3 \times 7$	63	102
$2 \times 2 \times 16$	64	136
$4 \times 2 \times 8$	64	112
$1\frac{1}{2} \times 6 \times 7$	63	123
$1 \times 10 \times 6$	64	128
$3 \times 4 \times 5\frac{1}{2}$	66	111

If charges for similar thickness of approximate date be considered on this basis, the puzzle as to their fairness or otherwise becomes clearer. If added to this the matter of standard planking relative to dimensions is considered, the facts may be startling. The case-maker is blamed in too many instances where blame is not due. He must perforce charge up the timber used, whether this is in the finished cases or wasted as firewood. It is, of course, totally impossible to avoid some wastage; but more might be done to conserve timber resources by a realisation of the facts, and the foregoing may serve a national no less than a utilitarian end. The nearer to cube dimensions the cheaper the case, and in most instances where two of the dimensions are similar and no undue disproportion exists, the case will be found little more expensive than the cube.

A cube case is extremely awkward to handle, and for this reason alone should not be employed. It is evident by calculation that little is sacrificed by making the length exceed the width and depth. Provided that the length does not exceed the sum of width and depth, its relative cost is not increased unduly. It is worth pointing out that for large cases where strength is also a prime consideration, the over-sea transit case may be tongued with hoop iron. This course sacrifices less of the inherent strength of the boards, and adds very greatly to its ability to resist damage.

ROUGH BOXES

An ordinary box is generally regarded as the simplest article that a wood-worker can have to construct, yet there are a good many wrong ways, as well as a right way, of doing it. If illustrations of how not to do it were given here they would be more numerous than those showing how to do it.

The arrangement of the parts in Fig. 1 shows the correct and professional way of making a small rough box. The ends are about twice as thick as the other parts, and fit between the sides. The sides and ends are first nailed together, and then the bottom is nailed on. The top corresponds with the bottom in being the full outside length and width of the box. Lines of nails running across the grain, as at the ends, are closely spaced, running with the grain, as in nailing along the sides of top and bottom the nails are much farther apart. If the box measures the same in each direction, the ends are shorter than the sides only by the amount required for lap at the joints, that is, the combined thickness of the two side pieces. If the

box is longer one way than the other, the length of the ends corresponds with the shorter inside measurement, and the length of the sides with the longer plus the thickness of the ends. In depth the sides and ends are alike, and represent the inside depth of the box.

Ends are made thicker because it gives greater rigidity and greater thickness for receiving the nails. In the sides, top and bottom, increased thickness has not such an advantage as in the ends. The effect would be the same if the sides were made thick and the ends thin, and the ends overlapped the sides; but this would be less economical of material, because the ends are shorter than the sides and consume less thick material. Exceptions occur when ends and sides are alike in thickness, and in a more highly finished class of work than that dealt with here it is the rule to make them alike. The reason for spacing nails closely across the grain, and at long distance with the grain, is that in the first case the wood may split or warp, and requires to be secured at close intervals. It has very little strength in this direction. But along the grain, nails needlessly close add nothing to the strength of the box, and may, by their excessive number in one line of fibres, split the piece into which they are driven.

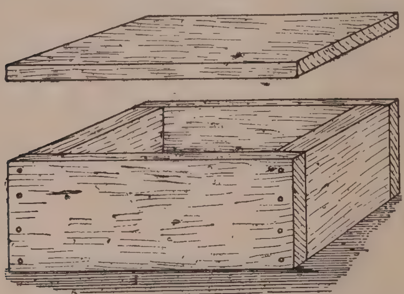


Fig. 1.—Method of Putting a Box Together

Fig. 2 shows methods of jointing box corners alternative to nailing; A is a dovetailed corner and B a lock corner. There are many other ways of jointing, but none that is used much in box construction. The dovetailed joint is not often used for rough boxes. The lock corner is used a great deal for small boxes. In factories dovetails and lock corners are cut by machines. The lock corner is never made by hand; dovetails occasionally are. Both of these joints are glued, and not nailed. Bottoms and covers have to be nailed on even when the corners are locked or dovetailed.

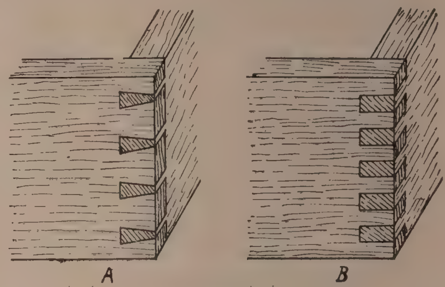


Fig. 2.—Dovetail and Lock Corner Joints

Only small boxes can be made of single widths of wood. Large cases always have to be built up of a number of pieces edge to edge, to make the widths required. This is because there is a limit to the width of wood obtainable; but a box is just as strong, and there is no objection at all to building up in this way in rough boxes. In highly finished work it involves the extra trouble of gluing the pieces edge to edge; but otherwise they are simply placed together, often with slightly open joints. It is essential to have the lengths right, end-grain joints in boxes, and in most other work, being out of the question. Bottoms and covers are usually wider than the sides and ends, and therefore, as boxes go up in size, the necessity for building up in widths occurs first in the bottom and

Fig. 3.—Ordinary Type of Packing Case

covers. This is because a shallow-box is usually more convenient than a deep one of equal capacity. It is an advantage to have the sides and ends in single pieces, because it simplifies the work of nailing them together; but a bottom or cover can be nailed on almost as qu ickly and

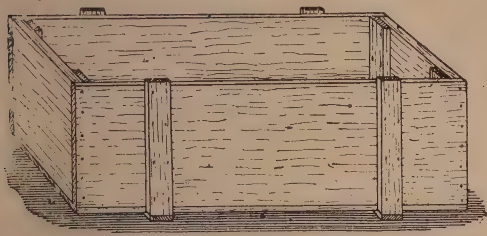


Fig. 4.—Packing Case with Cleats on all Parts

easily if it consists of half a dozen pieces as it can when in a single piece.

When above moderate dimensions in boxes, it becomes necessary to use cleats or battens crosswise on the grain, both to strengthen the box and to facilitate building it up. The need for these arises as soon as the sides and ends exceed a width easily obtained in single pieces, say more than about 12 in.; but even single pieces above this width need stiffening with cleats, and cleats serve a further purpose of thickening up the ends or sides

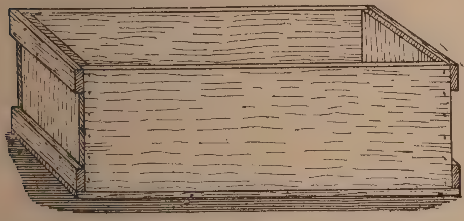


Fig. 5.—Packing Case with Corner Cleats

at the corners, so giving a larger joint surface and permitting the use of thinner wood. The thick ends shown in Fig. 1, therefore, become unnecessary when cleats are used, as in Fig. 3. The latter shows a first stage where cleats are used on the ends only. This type of box probably occurs more frequently than any other. Its ends can be built up of two or more widths, which are held together by nailing on the cleats. There is no difficulty then in nailing the sides to these, also in more than one width, but without any need for cleats. The bottom and cover also can be nailed on without cleats, and in as many separate pieces as happens to be convenient.

Fig. 4 shows how a much larger class of box or case is made. Here the areas are so great that cleats are used on all parts. A rather remarkable point to be noticed here is that it is the great length and not the widths that makes cleats necessary on the sides and bottom and top; for no matter how wide these latter happened to be, they would, if not very long, be amply secured by the nailing at the ends. But when the length is considerable they are not capable of withstanding a severe blow in the middle part without springing or perhaps even breaking, either of which might damage the contents of the case. An alternative would be to use much thicker wood; but the increase would have to be so great that it is far better to use thin wood and put cleats across to stiffen it. The number of cleats used depends on the size of the case. Cleats may be outside or inside. Very large cases always have outside cleats. In Fig. 4 the ends are shown cleated on the inside, which is a variation from the method in Fig. 3. Both are equally good; but in some instances inside cleats might interfere with the packing of goods in the box,

The arrangement shown in Fig. 5 is occasionally seen, but is much less common than that in Fig. 3. It is best suited for comparatively deep and narrow boxes, as the grain of the ends then runs the longest way of the pieces, which is advisable in all woodwork. The cleats would generally overlap at the ends as shown.

CRATES

Crates have alternate bars and spaces, but are otherwise constructed in the same way as large boxes. First the article to be crated is measured, and the position of the ends of the crate in relation

to it decided, the ends being usually the parts of smallest area. A pair of these is made by cutting a number of bars to the length required, and laying them side by side with spaces between, and nailing other bars or cleats on at right angles to hold them together. The construction of the crate then proceeds in the same way as with a closed box, except that bars are nailed on instead of continuous wood for sides, top, and bottom. More bars or cleats at right angles may be put on these. When the area is large, they are often put on diagonally to keep the crate from being knocked out of square.

In all cases, the nails which hold cleats are longer than the double thickness of wood, so that their points can come through and be clinched. Nails in other parts, going into an unlimited depth of wood, should be in length about three to four times the thickness of the wood through which they are driven.

In nailing a box together, its squareness is determined when the bottom is being put on. Previous to this the sides and ends are in a rickety condition, and may be forced very much out of square in relation to each other. As soon as the bottom is on, the box is rigid, but is not necessarily square unless precautions are taken to see that it is so at an early stage in the nailing on of the bottom. If the bottom is in a single piece and is sawn square, all that need be done is to see that it is nailed on correctly; but if it is in a number of separate widths, the box should be tested before the nailing of the first piece is completed. Testing is done with a square or by measuring diagonally across corners. If the latter shows alike in opposite directions, the box is square. If slightly out, it must be forced right before any more nails are put in.

PACKING CASES

A large packing case as used by large business houses for packing and sending hardware goods abroad should be made in the following manner. It will be supposed that the dimensions of the sample case are to be 4 ft. long, 2 ft. 3 in. wide, and 1 ft. 6 in. deep. It must be remembered that the case will have to be $\frac{1}{3}$ in. smaller in each dimension. The reason for this is that "hold space," which is charged by the cube foot, shall not be exceeded, as the excess charge on a number of cases would be a heavy item.

The case should be made of rough 1-in. boards 8 in. and 9 in. wide, and fastened with $2\frac{1}{2}$ in. wire nails. Begin with the bottom ledges, of which in this case there are three. Fig. 6 shows them spaced. These are of 8-in. board cut off $\frac{1}{4}$ in. shorter than the actual width of the case; that is, $\frac{1}{8}$ in. off each side, so as not to project beyond the sides of the case. These boards will thus be 2 ft. $2\frac{3}{4}$ in. long. Next cut off two pieces of 8-in. stuff and one piece of 9-in. board 3 ft. $9\frac{3}{4}$ in. long

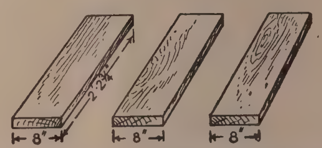


Fig. 6.—Bottom Ledges for Packing Case

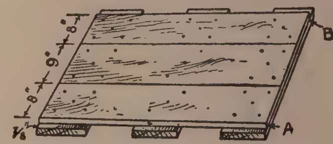


Fig. 7.—Packing Case Bottom

to make the bottom boards. By cutting these boards 3 ft. $9\frac{3}{4}$ in. long this allows 2 in. for the two 1-in. end pieces. Place these pieces side by side on the ledges, as in Fig. 7, with the 9-in. board in the centre as shown. They should be nice and square, with the ledges projecting each side $\frac{7}{8}$ in., and the nail right through both the bottom boards and ledges and into the floor. This will keep all firm while building up the case. Now measure across the bottom (from A to B, Fig. 7) to get the length of the first two boards for the ends. These are of 8-in. stuff. Stand these upright at the ends of the bottom boards, with their edges on the floor, and nail right through into the side of the end

ledges, with two nails opposite the end of each board, and one nail into the end of each bottom board as well. Having fixed the first two end boards as shown in Fig. 8, get out the first two side pieces. Take a stick and measure from A to B for these, and be sure and lay the stick on the ledges where the side is to go, not higher up the end pieces already fixed, as these might be standing either in or out a little, and so prevent the true measurement being taken. Fig. 9 shows the first two side pieces nailed in position, and also how the side boards stand about 1 in. higher than the ends, thus breaking the joints. Next get four inside corner cleats, as shown in Fig. 10. These are 1 in. by $4\frac{1}{2}$ in. and 1 ft. 6 in. long, less the thickness of the lid, the bottom boards, and the ledges underneath the bottom boards, and $\frac{3}{8}$ in., to allow for the 3 in. of stuff, as before explained. Therefore, these cleats will be 1 ft. $2\frac{5}{8}$ in. long. Having cut these to length, place them in the four corners, as shown in Fig. 10, and nail edgewise, first through the ends, then through the sides, and clinch inside.

Then continue the building of the case to the top of the cleats, putting a piece of 9-in. above the 8-in. piece at the ends, and 8-in. pieces to finish the sides. Nail and clinch as before. Having finished building the case, lever it up from the floor with a piece of board. Turn the case upside down and clinch all the nails in the bottom. Also put a couple of nails through the ends of each ledge into the sides, and the case is ready for being packed. Then the lid is made and nailed on (Fig. 11). As a rule, the lid requires no ledges. A 1-in. board is simply nailed across the case lengthwise, and cut off at the end of the case. If extra strength of lid is required, a piece of $4\frac{1}{2}$-in. stuff is let into the sides across the top of the case, so that it is flush with the top before the lid goes on. The lid is then nailed on as before described.

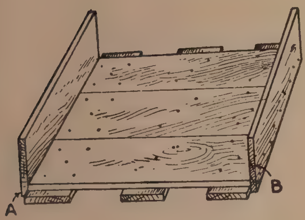


Fig. 8.—Packing Case with Ends Partly Fitted

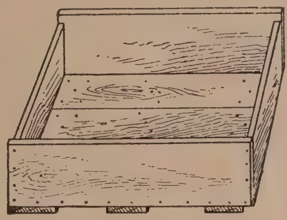


Fig. 9.—Packing Case with Ends and Sides Partly Fitted

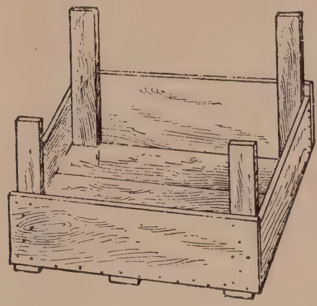


Fig. 10.—Packing Case with Corner Cleats Fitted

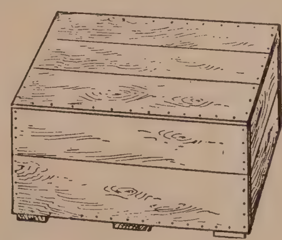


Fig. 11.—Packing Case with Lid

Drawing and Other Boards

A GOOD drawing-board should be light, perfectly square, true on its surface, free from knots and shakes and from any tendency to warp. Fig. 1 shows a back view of an engineer's drawing-board. It has a $\frac{3}{4}$-in. pine top of standard size, with two $3\frac{1}{2}$-in. by $\frac{5}{8}$-in. oak ledges screwed at the back to prevent warping. The screws are fitted into slotted metal plates, upon which they slide freely and so prevent the board splitting during shrinkage. As a further prevention against any tendency to "cast," the underside of the board is furnished with a series of shallow grooves from 2 in. to 3 in. apart and one-third of the thickness of the board deep. These grooves, by destroying the continuity of the fibres of the wood, materially reduce

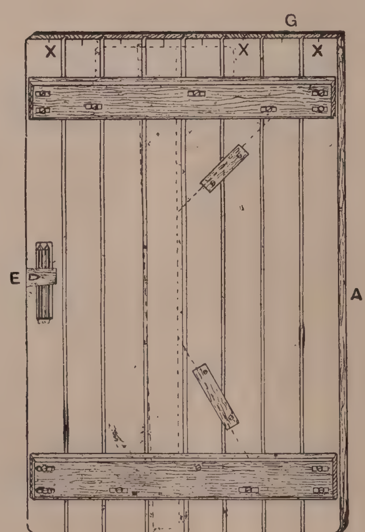


Fig. 1.—Back View of Engineer's Drawing-board

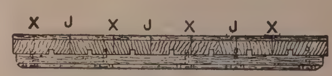


Fig. 2.—End View showing Grain

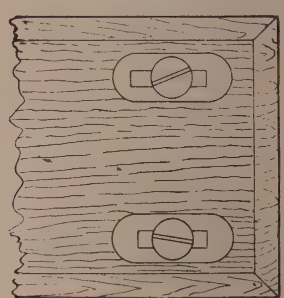


Fig. 3.—Attachment of Ledges

the pull of the top on the ledges, and enable the latter to be made thinner than would otherwise be possible; consequently, the board is lighter. The grooves may be of any width, from a saw kerf to $\frac{3}{8}$ in., but must not be made at a joint.

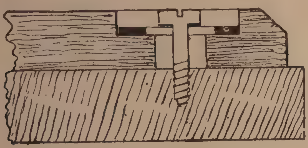


Fig. 4.—Section of Ledge

The left-hand, or the working hand of the board, is slipped or inlaid with a piece of ebony to prevent the T-square wearing the edge hollow. This slip, in machine-made boards, is usually grooved in at about $\frac{1}{4}$ in. below the upper surface of the top; this, however, is not its best

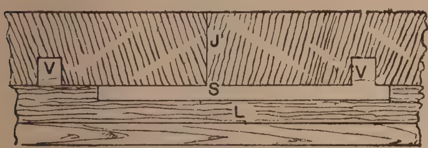


Fig. 5.—Part Cross-section of Drawing-board

position, and it should be placed, as shown in Fig. 6, flush with the surface, the ebony slip G being glued and fixed with wood sprigs in a small rebate.

The grain of the slip must run lengthwise across the board to furnish a smooth surface for the square to work against,

Fig. 6.—Section of Drawing-board at Slipped End

and it is obvious that, as this piece cannot shrink endwise, the board would split during shrinking unless some means were provided to give the necessary play. This is done by running several tenon saw kerfs down the end of the board just through the slip, as shown at X (Fig. 1), the spaces between the cut ends affording sufficient room for subsequent contraction.

The joints in the top should not be ploughed and tongued, and need not be dowelled if the board is glued up in pieces not more than 5 in. or 6 in. wide. Particular attention must be paid to the position of the annular rings. To enable a board to maintain a true surface the rings must run, as shown in Figs. 2 and 5, at right angles, or nearly so, with the surface; if a piece of stuff is used with the rings running parallel with the surface the board cannot keep flat.

Machine-made boards are usually planed dead-true on the surface; some draughtsmen, however, prefer to have one slightly convex in both directions, as this allows

Fig. 7.—Section of Pencil Well

Fig. 8.—Metal Slot-plate

the paper to bed much better and the T-square to travel easier. The convexity must only be slight, say a bare $\frac{1}{8}$ in. for an imperial or larger board, and $\frac{1}{16}$ in. for smaller sizes; the method of producing it will be explained later.

Two little accessories introduced in the board shown by Fig. 1 will be found useful to technical students who have to carry their own boards to drawing classes. The first is a provision for carrying the T- and set-squares at the back of the board; the positions are indicated by dotted lines. The blade of the T-square passes through slots in the ledges, as seen at S (Fig. 5), shallow recesses being made in the interior of the ledges to receive the bases of the set-squares, and two thin rebated fillets to receive their hypotenuse edges. The set-squares are placed in position first, and are then secured by the T-square, which should fit accurately into the slots. At E (Fig. 1) a receptacle for pencils is

shown. This is a well cut as long as a pencil, $\frac{7}{8}$ in. wide and $\frac{3}{8}$ in. deep (*see* Fig. 7), one end being undercut to receive the pencil ends, whilst at the middle there is a small slide having dovetailed edges and a thumb notch at the outer end.

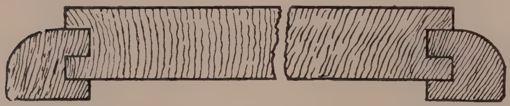


Fig. 9.—Section Through Simple Drawing-board

In making such a board, the first thing to be decided on is the size, which should be 1 in. wider and longer than the standard size of drawing paper. The sizes of paper most frequently used are half-imperial, 15 in. by 11 in.; royal, 24 in. by 19 in.; imperial, 30 in. by 22 in.; and double elephant, 40 in. by 27 in. Of these, perhaps imperial is the most useful, and the board should therefore be 31 in. long, 23 in. wide, and a full $\frac{3}{4}$ in. thick. The wood used should be American yellow pine, thoroughly seasoned, dry, and free from knots, shakes and sapwood. Assuming the boards to be 11 in. wide, three pieces 2 ft. long will be required; these should be ripped down the middle and jointed with the outside edges together, and mixed—that is, no piece must be glued to the piece from which it was ripped. After shooting, plough the grooves V (Fig. 5) $\frac{1}{4}$ in. deep down the centre of each piece on the worse side; then glue up, using two cleats. When dry, plane the back true, gauge to the thickness, and face up the front.

If a convex surface is required, take some thin stuff and prepare a hollow straightedge having the required sweep, which may be obtained by a compass plane, or even by a trying plane with the iron set coarse. Work the face of the board down lengthwise to fit the template. The cross convexity is obtained by preparing the ledges by the same template, and drawing the board round with the screws.

The next thing to be done is to square the board off to size; the edge marked A (Fig. 1) is shot straight, and the opposite edge is gauged parallel and shot. The end G is squared from the edge A. If a square of sufficient length is not at hand, a line may be drawn at right angles as follows: Mark its beginning and measure 12 in. from it on the edge A; take a straightedge and set off 9 in. on its edge, put the straightedge on the board with one end to the beginning of the line, and place it in such a position that the 9-in. mark is exactly 15 in. from the 12-in. mark, measured diagonally; it will then be square with the edge. The other end can be squared in a similar manner.

Prepare an ebony slip, 2 ft. long and $\frac{1}{4}$ in. square, and sink a rebate a shaving less across the end to receive it. The slip is glued in, the best way to hold it up whilst drying being to fix a piece of stuff on the bench to rest the end of the board against, and to screw another fillet 1 in. clear of, and at a slight angle to, the other end, so that a long wedge may be driven between the fillet and the slip, tightening the latter up throughout its length. After the glue is dry and the superfluous wood cleaned off, put half a dozen cleft ebony sprigs through the face, making the holes with a fine bradawl; also make a saw kerf between each groove, as shown in Fig. 1.

The ledges, which should be of mild, straight-grained American oak or Honduras mahogany, straight or convex on the face, as desired, should be gauged $3\frac{1}{2}$ in. wide by $\frac{5}{8}$ in. thick, and cut them off $\frac{1}{2}$ in. short of the width of the board. Work a $\frac{1}{4}$ in. chamfer all round, as shown in Fig. 3, and bore the screw holes a trifle wider than the screws, and $\frac{1}{2}$ in. long. The centre screw in each ledge is not slotted. The slot-plates are formed of brass or zinc (*see* Fig. 8), $1\frac{1}{4}$ in. by $\frac{1}{2}$ in. by $\frac{1}{16}$ in. The screws have squared heads, No. 5 in size. The plates should be sunk into the ledges to such a depth that the heads of the screws are flush (*see* Fig. 4).

The board may then be glasspapered in the direction of the grain and given a coat of hot size on both sides, the ends being given two coats to prevent damp entering the pores. In Figs. 1, 2, and 5

J indicates the joints in the boards, X the saw kerfs, E the dovetailed slider, S the slot in the ledges, L the ledge, and V the grooves for preventing casting.

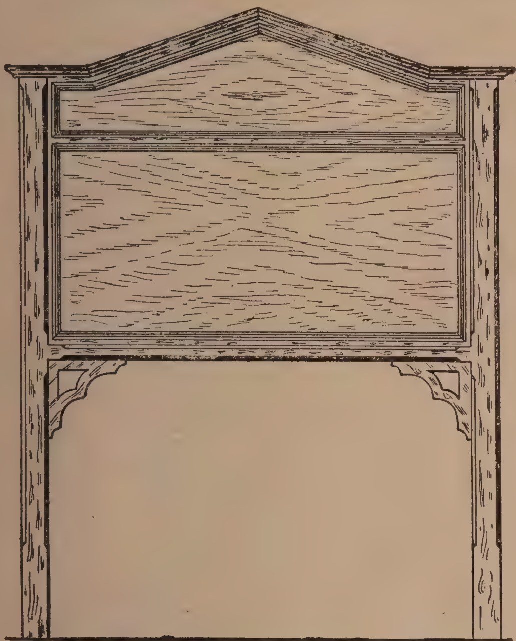


Fig. 10.—Front View of Standard Notice Board

Fig. 13.—Section of Fig. 10

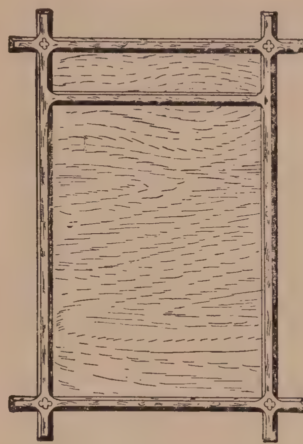


Fig. 11.—Front View of Framed Notice Board

Fig. 14.—Section Through Top of Fig. 10

Fig. 16.—Half Plan of Fig. 11

Fig. 17.—Half Plan of Fig. 12

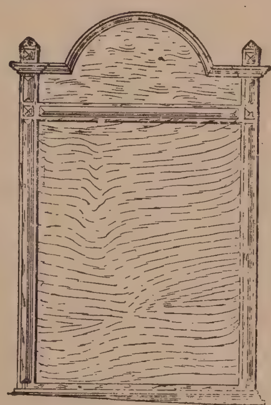


Fig. 12.—Front View of Framed Notice Board of More Elaborate Design

Fig. 15.—Half Plan of Fig. 10 showing Battens at Back

Another method of constructing a drawing-board at much less expense, although equally good, is shown by Fig. 9. It consists in fitting two shaped hardwood grooved fillets into corresponding grooves and tongues formed in the ends of the board. The grooves in the board should be exactly central, and should be slightly more than one-third of the board's thickness. The tongue and groove in the fillet should fit accurately, and be reversible so that each surface of the board may be

used. The width of the fillet will depend on the size of the board. Oak, beech, or Spanish mahogany are the most suitable woods for the purpose, and the fillets should be fitted rather tightly at first to allow for shrinkage. A little French chalk rubbed in the grooves will facilitate the removal when altering the positions of the fillets.

NOTICE BOARDS

The notice board shown by Figs. 10, 11 and 12 are suitable for public or other buildings. The board shown at Fig. 10 is mounted on standards, and those shown at Figs. 11 and 12 are suitable for attaching to the wall.

The standards for Fig. 10 are 4 in. square in section, sunk into the ground a distance of 3 ft. 6 in., and extend 7 ft. above the ground line. The cross rail is 4 in. by 2 in. in section, tenoned into the standards 3 ft. 6 in. up from the ground line; the width over the standards is 6 ft. The bracket pieces are 1 in. thick by 1 ft. long each way, tenoned into the standards and cross rails. The edges of the standards and cross rail are stop-chamfered, as shown at Fig. 10.

The panelling is 1 in. thick, and should be of well-seasoned, straight-grained stuff free from knots and shakes; it is rebated into the standards and cross rail, and fixed with screws. The rise of the board in the centre, at the top, is 9 in. The joints of the panelling are grooved and tongued, and strengthened with three battens, 3 in. by 1 in., fixed to the back with screws. The top is $5\frac{1}{2}$ in. wide by $1\frac{1}{4}$ in. thick, jointed round and fixed to the top of the panel and standards, the front edge being moulded as shown. A moulding 2 in. wide by $\frac{3}{4}$ in. thick is mitred round the edges and across the panel at the top, dividing it into two portions. The top portion is intended for the name of the building or institution, and the bottom for the usual notices. Fig. 13 is a vertical section of the board, Fig. 14 an enlarged detail of the top at A, and Fig. 15 is an enlarged half plan.

The board (Fig. 11) is of very simple construction, and consists of a frame half-lapped together with a panel rebated and fixed to the back. The stiles are 2 in. squares in section, and the outside dimensions over the stiles when framed together are 4 ft. 8 in. high by 3 ft. wide. A frieze rail 2 in. deep by 1 in. thick is lapped 6 in. down from the top rail and fixed with screws. The front edges of the stiles are chamfered as shown, and the back edges are rebated 1 in. square for the reception of the panel, as shown at Fig. 16. The panelling is 1 in. thick, fixed to the frame with screws.

Fig. 12 shows a more elaborate board suitable for fixing to the wall. The outside dimensions are height 5 ft. and width 3 ft. The side stiles are $2\frac{1}{2}$ in. wide by 2 in. thick, bottom rail 3 in. deep by 2 in. thick, and top rail $2\frac{1}{2}$ in. deep by 1 in. thick. The frame is mortised and tenoned together, the height over the rails being 3 ft. 9 in. The faces of the top and side pieces are cut to represent raised panels, and the bottom rail and stiles are rebated 1 in. square to receive the panelling, which is fixed with screws. A moulding $1\frac{1}{2}$ in. deep is mitred round the top, and a moulding 2 in. deep is mitred round the bottom. A half plan of this board is shown in Fig. 17.

ROLL OF HONOUR

This Roll of Honour, a photograph of which is shown in Fig. 18, is suitable for a church, club, or office, and is intended to be reproduced in oak with an oiled and wax-polished finish. The work is not too difficult for any craftsman to undertake, and if carried out to the dimensions shown, it will be large enough to contain up to forty names; but the size could be varied to meet individual requirements. It is very important that the wood should be quite dry, and carefully selected.

The back is framed and panelled. The stiles A (Fig. 20) are 3 ft. $8\frac{1}{2}$ in. long by $2\frac{1}{2}$ in. wide by $1\frac{1}{8}$ in. thick; top rail B 2 ft. 5 in. long by 6 in. deep by $1\frac{1}{8}$ in. thick, shaped as shown in Fig. 21, and bottom rail C 2 ft. 5 in. long by 5 in. deep by $1\frac{1}{8}$ in. thick, shaped as shown in Fig. 22. The

framework is mortised and tenoned together, as shown in Fig. 20, the tenons on the top and bottom rails being haunched in $\frac{1}{4}$ in. from the inner edges to allow for the grooves which are cut to receive the panel. The grooves are $\frac{3}{8}$ in. wide by $\frac{1}{4}$ in. deep. The stiles are made up to the wide (Fig. 19), and of the section shown in Fig. 23. The frets G are 2 ft. long by $2\frac{1}{4}$ in. wide at the bottom shaped out to $\frac{1}{2}$ in. wide by $\frac{3}{4}$ in. thick, and are grooved into the outer edges of the framework (*see* Fig. 23). In cutting the frets, $\frac{1}{4}$ in. extra in width must be allowed to form

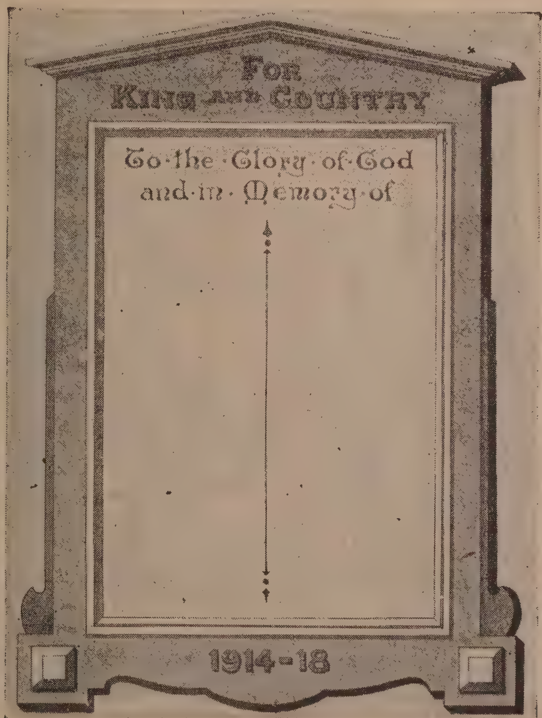


Fig. 18.—Roll of Honour

required width at the bottom with pieces D, which are glued in position. The panel E is $\frac{3}{8}$ in. thick, grooved into the edges of the framework, as shown in Fig. 23. If it should be necessary to use two pieces to make up the width required, it will be best to use pieces of equal width so that the joint will be exactly in the middle. The joint should be tongued (*see* Fig. 23).

The moulding F, which is mitred around the inner edges of the framework, is 1 in. the tongues which fit into the grooves. The top moulding is made up with capping pieces H, $2\frac{3}{8}$ in. wide by $\frac{1}{2}$ in. thick, underneath which are mouldings J, 1 in. square, and of the section shown in Fig. 24. Raised and chamfered blocks K (Fig. 19) are fixed at the lower corners of the framework to form a finish, the blocks being $\frac{1}{2}$ in. thick, and of the shape and section shown in Fig. 25.

The inscription on the top rail and the

dates on the bottom rail are intended to be cut in wood letters about $\frac{1}{4}$ in. thick. The size for the letters and figures may be gathered from Figs. 21 and 22, and the cutting should be done with a fret-saw. Some care should be exercised in marking out and cutting the letters and figures. They are glued in position, and may either be left plain or gilded. The wording on the panel, together with the list of names, should be in gold letters, a suitable style of lettering being shown in Fig. 21.

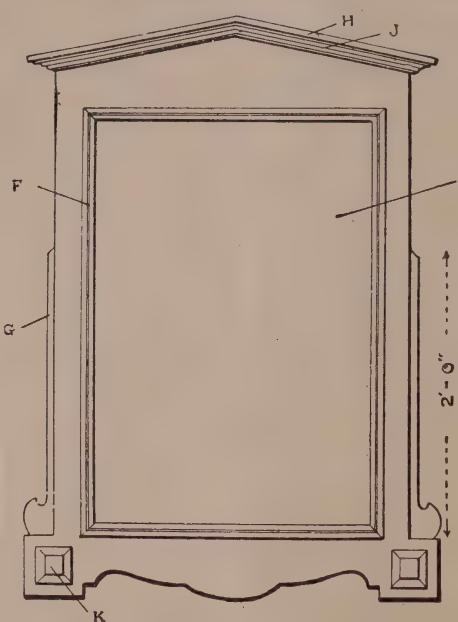


Fig. 19.—Elevation of Roll of Honour

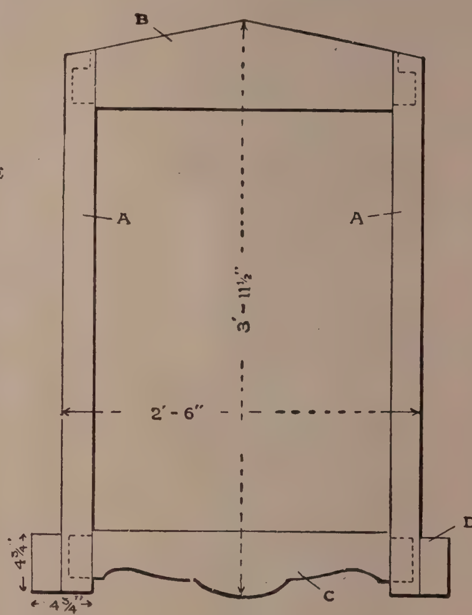


Fig. 20.—Framework of Roll of Honour

EMERGENCY POSTER BOARDS

The following are ideas for the construction of emergency notice boards.

Fig. 26 shows a board fitted with double rebated or grooved laths dividing it into sections, and surrounded on the outside edges with a similar piece of wood, but prepared with a single rebate on the inside edges. For an average board about 14 ft. of 1-in. by $\frac{1}{2}$-in. wood lath is required. Dealing with the preparation of these laths it is done very easily and simply by a rebate plane, or it could be done with a saw, chisel, and mallet. The detail of the sinking of rebate is shown in Fig. 27, $\frac{1}{4}$ in. deep and $\frac{1}{4}$ in. wide being sufficient. These rebates on the outside pieces should be stopped at the top to $\frac{3}{4}$ in. of the length of the lath at each end. This will be obvious on reference to Fig. 26. All could be finally nailed on with the exception of one of the outside ones, which should be screwed on after the movable slips are in position.

It is now seen that a frame is prepared to receive these latter, composed of cuttings of linoleum obtained at very small cost. Preferably it should be brown, grey, or any of the darker shades, of course without pattern on its surface, and being divided into sections; almost the smallest odd piece left over after covering a floor will be sufficient, whereas if covered in one difficulty might be experienced in getting

a piece large enough. The suggestion of its being mounted by nailing on three-ply wood or "Venesta" secured from discarded tea boxes, applies more to the very thin qualities of linoleum, although possibly it would be a wise course in any case to stiffen the linoleum in this manner.

diagram, namely, to keep the lettering straight. Of course, a damp cloth will easily remove the chalk when alteration or adaptation is required.

Dealing with alternative schemes, a complete set of four alphabets on small sections could be prepared the height of

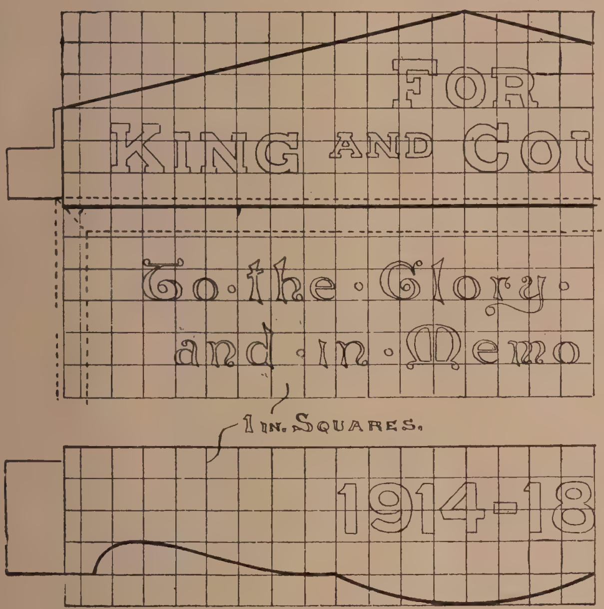


Fig. 22.

Figs. 21 and 22.—Top and Bottom Rails of Roll of Honour and Details of Lettering

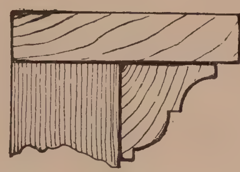


Fig. 24.—Section Through Top of Roll of Honour

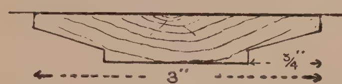


Fig. 25.—Section of Chamfered Blocks

Fig. 23.—Section Through Stile of Roll of Honour

When the board is complete the woodwork should be given two coats of paint to preserve it from weather.

In Fig. 26 the top section is suggested for chalking the name of a publication, while the remaining three sections may be used for the contents of the same. There is a further advantage of the sections as shown by the word "Victory" on the

the grooved laths apart and slipped in, in order to form any words desired. Half spaces should be provided each side of the letters. One does not suggest laboured lettering or anything of that sort, but just presentable wording. In this case the outside lath shown screwed on in Fig. 26 should be hinged with a small lock or catch to the intermediate laths, so as to

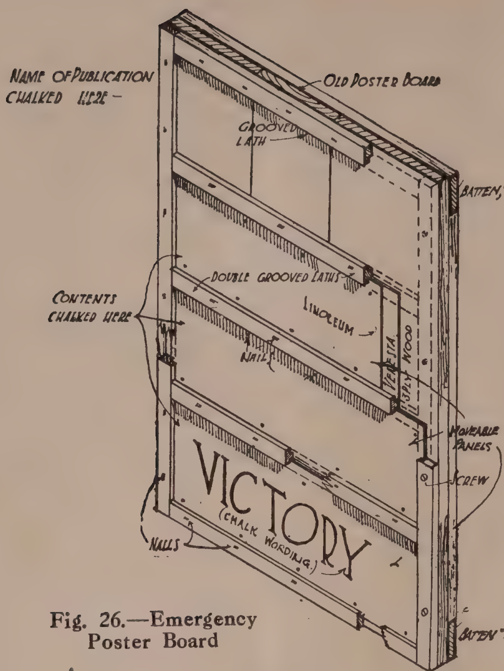


Fig. 26.—Emergency Poster Board

prevent unauthorised persons removing the letters.

Another method of displaying news is with a blackboard and chalk. A good preparation for making a durable and suitable surface is ivory or drop black, gold-size, with a little emery powder to roughen and so take the chalk. To make a sound job, a clamped board with shot edges should be made, and painted both sides with the above preparation. The next example shows a typical black board.

MAKING AND PAINTING A BLACKBOARD

To make the clamped blackboard shown by Figs. 28 and 29, best pine, free from knots and with a close grain, should be used. Material about 1 in. thick should be obtained, and this will be finished to about $\frac{13}{16}$ in. The board should be formed by jointing up two, three, or more 11-in. boards, depending, of course, on the particular size required. The best results are obtained if the joints are ploughed and a cross-tongue is inserted, all the joints being glued, of course. When the glue becomes hard, prepare the clamps. These are usually about 3 in. wide. The mortises in the clamps should be made and the inner edges ploughed to receive the haunching (*see* Fig. 30), after which the tenons and haunchings at each end of the board should be set out and made. Next glue the mortises and tenons, and fix the clamps by wedging the mortises and tenons together, after which each surface should be planed off true and smooth.

In painting a blackboard it should be remembered that all gloss should be absent, as unless the lighting of the room is very favourable a board having a glossy surface is sure to cause annoyance and trouble. A glossy board reflects the light, and, in consequence of this, it will be found that from some part of the room, at any rate, chalk marks on the board cannot be seen clearly. The following recipes and instructions are given as the result of much experimenting. The

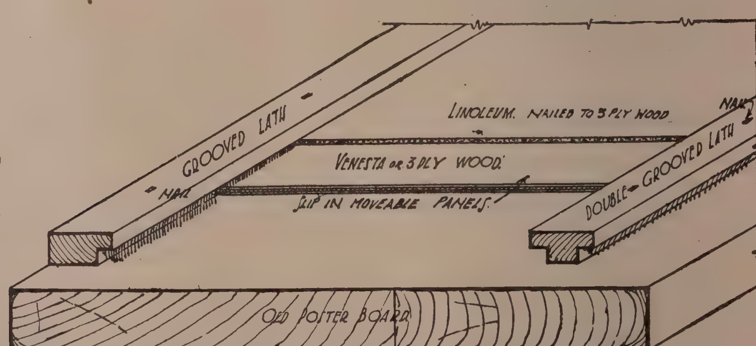


Fig. 27.—Details of Construction of Poster Board

compositions here given are all applied over two, or preferably three, good coats of colour made with white-lead, boiled oil, black pigment, and turpentine. Glass-paper each coat, which should be quite dry before the next is applied.

turpentine and 1 part of japan gold-size, and dilute with turpentine.

(3) Give two coats of black mixed with boiled oil; smooth, when dry, with flour emery-paper, then coat with black mixed merely with turpentine.

Fig. 28.

Fig. 29.

Figs. 28 and 29.—Front and Side Elevations of Blackboard

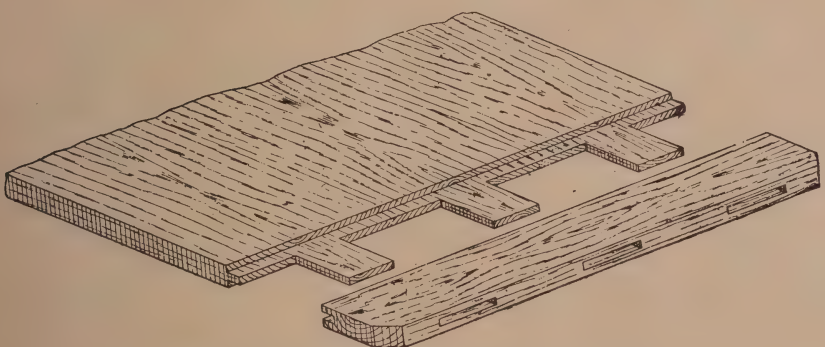


Fig. 30.—View of Blackboard showing Joints

(1) Give a coat of flat drop black and japan gold-size containing $\frac{1}{2}$ lb. of flour emery to 1 pt. of black pigment. When dry, coat again; but add a part of turpentine to 3 parts of gold-size used in the former coat.

(2) Coat thinly but evenly with common black and driers and 2 parts of linseed oil to 1 part of turpentine. When dry, spread quickly a mixture of 3 parts (by measure) of best ivory black ground in

(4) Give two coats of paint containing an excess of driers. Glasspaper the board after the first coat.

(5) Give two coats of varnish colour, containing just enough varnish to produce an "egg-shell" gloss. When thoroughly hard, rub down with felt and pumice powder, and leave for a few hours before using.

(6) The board should be well sized, and then coated twice with oily, dark lead colour or common black paint. Before

twenty-four hours have elapsed, apply a mixture of ivory drop black ground in turpentine, japan gold-size, or copal

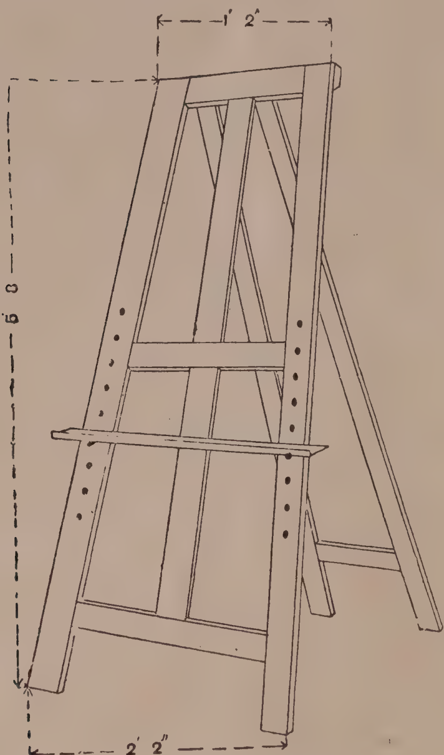


Fig. 31.—Sketch of Easel

varnish, and enough turpentine to give a thin watery consistency. This should produce a flat and lustreless black surface.

AN EASEL

The easel shown in Figs. 31 and 32 is suitable for studio or schoolroom. It is simple but rigid in construction. The wood may be spruce, yellow pine, or pitchpine, and should be about $2\frac{1}{2}$ in. by 1 in. in section. All the framework is mortised and screwed together. When

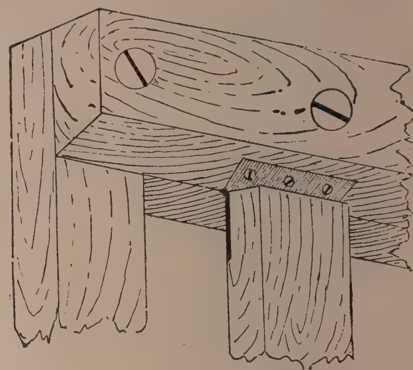


Fig. 32.—Detail of Hinged Leg

making the front part the rails are driven on to the centre stiles (muntins) and the outside stiles then cramped into position.

The detail shown in Fig. 32 gives the method of hinging the double leg. A cross piece is screwed to the top of the easel to receive the hinges. This cross piece is bevelled on the lower edge, the amount of bevel determining the limit of the spread of the legs, which should not exceed about 2 ft. from the front legs. The hinges are preferably screwed on the face of the legs as shown, but if screwed on the *ends* of the legs the screws should be not less than 2 in. long; even then, they may not hold very well, but this will depend largely on the quality of the timber.

Holes are bored in the front of the easel to hold pegs which support the board. A ledge is shown in the general view (Fig. 31), and this is useful for holding such things as chalk, instruments, painting materials, etc.

Plain Tables

EASILY-MADE KITCHEN TABLE

The strong and serviceable kitchen table shown by Fig. 1 is of easy construction, and one that can be put together in a few hours.

The method of jointing is entirely different from the usual variety, rendering the making extremely simple, even to a beginner, the sides being merely halved together and slotted into the legs. Being simple to prepare, a greater degree of accuracy can be secured by a beginner, and consequently stronger joints obtained when glued up than by an ill-fitting mortise-and-tenon. The measurements given for the parts are for a table with a top of the dimensions mentioned; they can, of course, be adjusted according to requirements. Fig. 2 shows how the sides of the table are halved together for fitting into the legs, the joint being shown complete in Fig. 3.

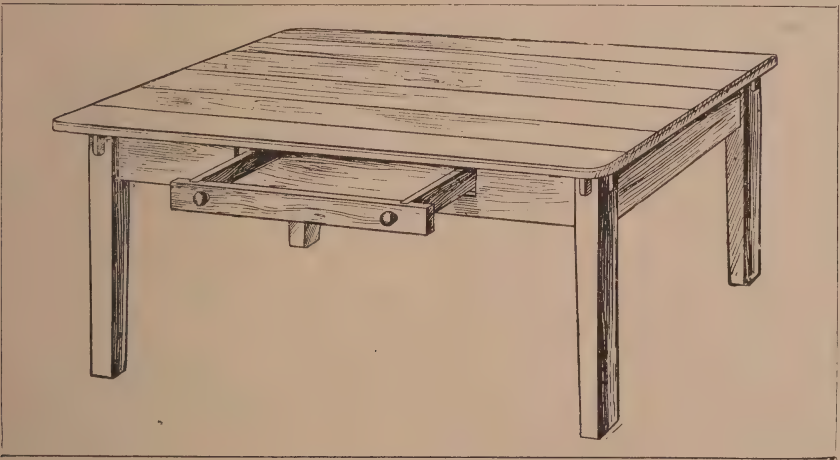


Fig. 1.—Kitchen Table with Drawer

Begin by cutting the sides, the shape and measurements for which are given in Fig. 4. These are prepared from boards 6 in. by $\frac{3}{4}$ in. Set the shapes out very carefully, for the success of the table will depend very largely on their fitting well. The simplest way, after truing up the planks, will be to set out a rectangle

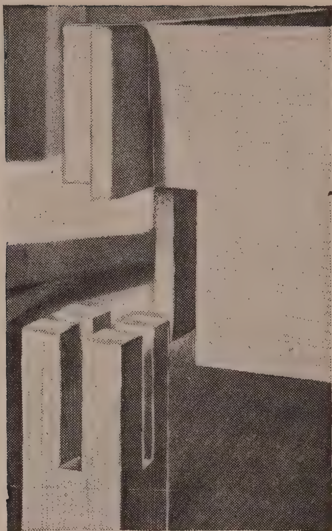


Fig. 2.—Joint of Leg of Kitchen Table

measuring $3\frac{1}{2}$ in. by 3 in. at the bottom lower corner of each piece and saw it out, afterwards setting out and cutting away the slots for halving the pieces together, these being cut in the lower edge of the long sides and the top of the short ones. After cutting the joints the sides may be fitted together, as shown in Fig. 2, the next item being to cut the slots in the top of the legs.

Prepare four pieces of $2\frac{1}{2}$-in. quartering 2 ft. $4\frac{1}{2}$ in. long, two lines being scored on each face in the centre at a distance of $\frac{3}{4}$ in. apart. This is done most accurately and simply with a marking gauge. Set the stock of the gauge $\frac{7}{8}$ in. from the spur, and then proceed to score the lines in the manner shown in Fig. 5, the stock of the gauge resting against the edge of the wood whilst the tool is worked away from the operator, just enough pressure being applied to cause the spur to enter the wood. The lines are carried across the end in the manner indicated in the illustration, and then a line is carried at right angles right round the wood 3 in. from the top (*see* Fig. 6). Saw down to this line, when the waste can be easily chiselled out, the result appearing as in Fig. 2. See that the bottom of the cut-out part is rasped quite flat.

Before gluing up the joints the legs can be planed to a taper if desired, and the hole cut for the drawer in one side. In the table shown by Fig. 1 this is made in one of the long sides, and measures 2 ft. 2 in. long by $2\frac{1}{4}$ in. wide. To cut out, set out the shape and drill a 1-in. hole with brace and bit at each corner, and then saw out with a pad-saw, afterwards rasping quite square and true. The framework can now be glued up with hot glue and the work allowed to dry. Fig. 7 shows the work at this stage, with the addition of the drawer supports, which are next applied. Screw a strip C to project $\frac{1}{2}$ in. above the bottom of the opening for the sides of the drawer to rest on, and then cut slots in this to take the drawer supports, the other ends of which rest on slotted brackets screwed to the opposite side of the table.

Fig. 8 shows a drawer of simple construction. The front is of $\frac{3}{4}$-in. stuff, the sides and back of $\frac{3}{8}$ in. Rebates are sawn in the front to receive the sides, which measure $\frac{1}{2}$ in. less in depth. Along the lower edge of the sides nail narrow strips to which the bottom of the drawer can be nailed. The strips need only be of very thin material, the back being cut to rest on it. Complete with a pair of handles. Should a drawer with an extended front, such as shown, be employed, the drawer bearers indicated in Fig. 7 will need to be fixed in a position for the sides to rest on, and narrow strips nailed along the outer edges to serve as guides. Fig. 9

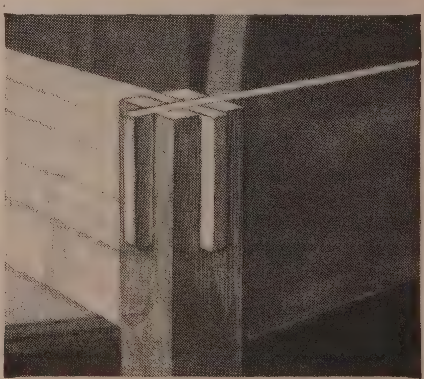


Fig. 3.—Leg of Kitchen Table Fitted

gives an underside view, showing the manner of framing together the top of the table, which could conveniently consist of table-top a piece will be required to be taken out of the top of each projection of the sides (*see* A, Fig. 7), also slots $\frac{3}{4}$ in.

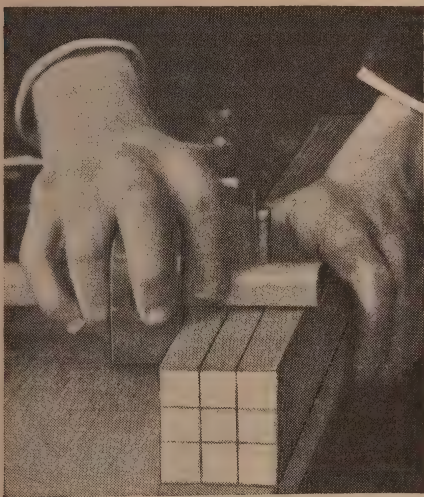


Fig. 5.—Marking Out Joint

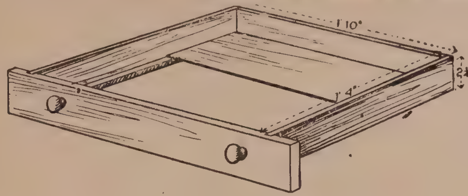


Fig. 8.—Drawer of Table

Fig. 9.—Underside of Top of Kitchen Table

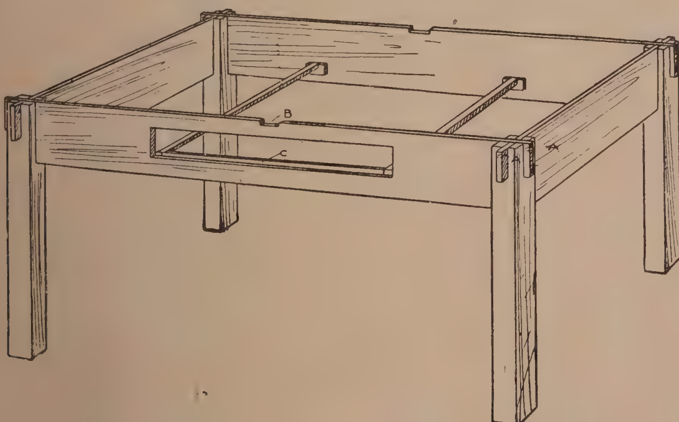


Fig. 7.—Framework of Kitchen Table

Fig. 6.—Leg Marked Out

Fig. 4.—Sides of Table

$\frac{3}{4}$-in. matchboarding edged round with 2-in. by $\frac{3}{4}$-in. strip, with a piece of similar strip across the middle. In fitting the by 2 in., shown by B, from the centre of the long rails, to enable the top to rest flat.

TABLE WITH DETACHABLE LEGS

The table illustrated (Fig. 10) will be found very convenient for packing away when not required; and though easily taken apart and re-fitted, is quite strong and firm. Fig. 10 is an elevation and Fig. 11 a plan of a table 3 ft. 2 in. long by 1 ft. 8 in. wide by 2 ft. 6 in. high. Should a wider table be required, a leaf may be fitted on one or each side; the addition of two 9-in. leaves would make it square.

The table is made of oak throughout, and the following is the material required: For the top, four pieces 3 ft. 2 in. long, 5 in. wide, and $\frac{3}{4}$ in. thick; for the rails, two pieces 2 ft. $7\frac{3}{4}$ in. long, and two pieces 1 ft. $1\frac{3}{4}$ in. long, all 5 in. wide and $\frac{7}{8}$ in. thick; for the corner pieces, four pieces $4\frac{1}{2}$ in. long, 5 in. wide, and $\frac{7}{8}$ in. thick; for the legs, four pieces 3 ft. 5 in. long, $2\frac{1}{2}$ in. wide, and $2\frac{1}{2}$ in. thick. There will also be required four $\frac{3}{8}$-in. iron bolts, nuts, and washers, and two and a half dozen 1-in. iron screws.

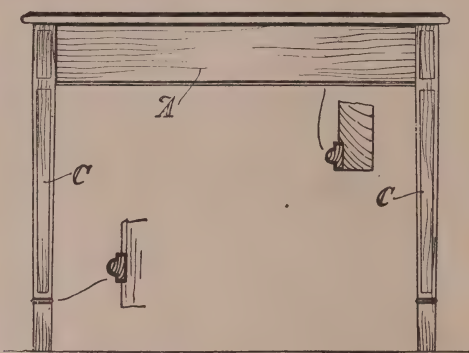


Fig. 10.—Elevation of Table with Detachable Legs

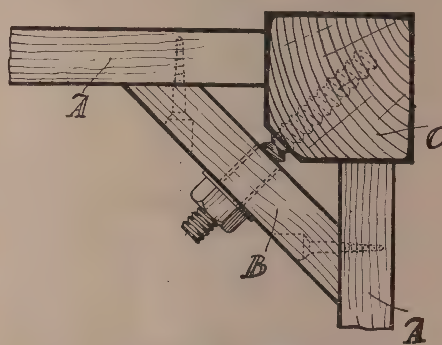


Fig. 12.—Enlarged Detail of Corner

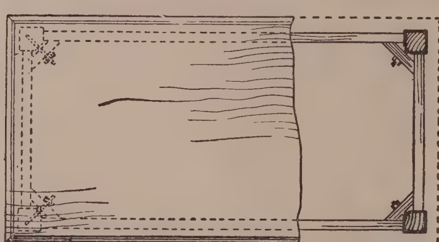


Fig. 11.—Plan of Table showing Part of Top Removed

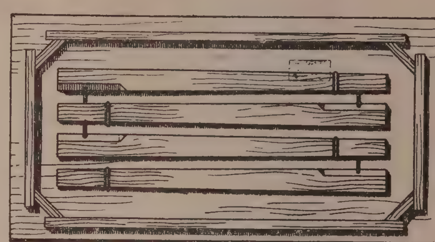


Fig. 13.—Underneath Plan of Table when Packed

The top is $\frac{3}{4}$ in. thick, and is joined together in widths (*see* Fig. 11) to make up 1 ft. 8 in.; the narrower the boards are the better; but that, of course, means more work. The boards are either tongued and grooved (end-grain tongues), or dowelled, and well glued and cramped. When properly set and dry, the top is squared up to length and breadth. If leaves are to be fitted, the corners should be left square; if not, they should be rounded. The lines for the positions of the 5-in. by $\frac{7}{8}$-in. rails A (*see* Figs. 10 and 12) are then marked on the underside, $1\frac{1}{8}$ in. and 2 in. from the edges, the ends of the rails being $3\frac{1}{8}$ in. from the edges. The four rails are worked to the width, and the edges carefully squared. The

two side rails are cut 2 ft. $4\frac{1}{4}$ in. long, and the two end rails 1 ft. $1\frac{3}{4}$ in.; care should be taken that the ends are perfectly square from both the top and the sides. The rails are glued to the top, and further secured with stout 2-in. iron screws. The screw-heads are let down $\frac{1}{8}$ in., and a clean hole the size of the head is bored with a centre-bit to enable a dowel to be glued over the head.

Fig. 12 is an enlarged section of one of the corners. The angle pieces B are $4\frac{1}{2}$ in. long by 5 in. wide by $\frac{7}{8}$ in. thick, with the ends cut to a true mitre, and are glued and screwed to the top and to the side-rails. The legs C (*see also* Fig. 10) are 2 ft. $5\frac{1}{4}$ in. long. The upper part for 9 in. is planed up $2\frac{1}{4}$ in. square, the lower part being tapered to $1\frac{1}{2}$ in. at the bottom. The middle part of the legs may be left square with a small chamfer taken off each corner, or turned, reeded, or fluted. On the upper inside corner, for a depth of 6 in., a chamfer is taken off, $\frac{5}{8}$ in. from each edge, which gives a face $\frac{7}{8}$ in. wide (*see* Fig. 12); while $2\frac{1}{2}$ in. from the top of the leg a hole is bored square from this face to take a $\frac{3}{8}$-in. wood-cut screw. The bolts used are $\frac{3}{8}$ in. in diameter by $3\frac{1}{2}$ in. long, with a wood-cut screw at one end 2 in. long and an iron-cut thread, 1 in. long, with a nut at the other. The bolts are worked into the legs with the aid of the nut, which acts as a temporary head, after which the nut is taken off. Holes are bored in the angle pieces large enough to let the bolts pass through easily, their centres being $2\frac{1}{2}$ in. from the edges.

The legs having been placed in position, the bolts are passed through the angle pieces. A washer is then placed over the bolts, and the nuts put on and worked up steadily, so that they bear an equal strain. This makes a very rigid frame. Should there be signs of racking at any time, this may be remedied by tightening the nuts. If there is any difficulty in obtaining the bolts, $\frac{3}{8}$-in. coach screws, or handrail screws, may be used instead. When disconnecting the parts, the nuts are removed, and the legs taken off and stowed under the top of the table, as shown in Fig. 13, which is an underneath plan of the table packed ready for removal. By this method of construction the cutting of mortises and tenons is avoided, and much time saved.

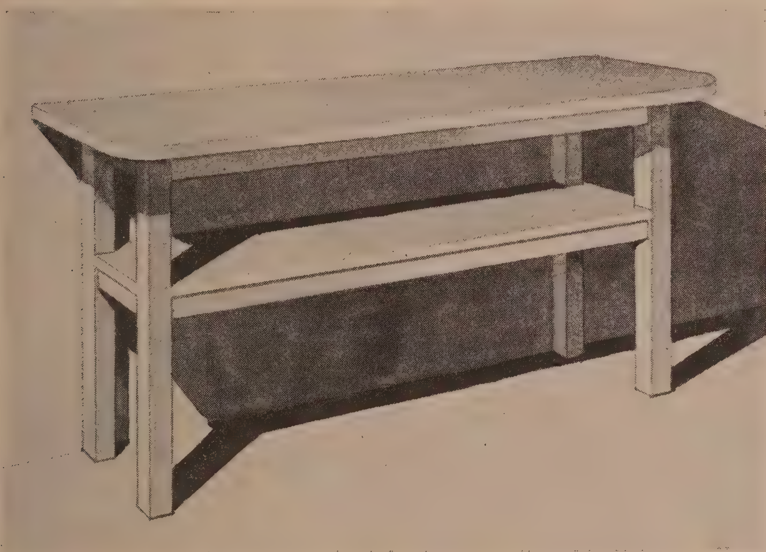


Fig. 14.—General View of Side-table

SCULLERY SIDE-TABLE

The kitchen or scullery side-table illustrated in Fig. 14 is shown and described precisely as actually made; but would naturally be modified in detail in order to suit particular cases. Fig. 15 is a front view.

To construct the table, first frame up the two ends, each of which comprises two 2-in. square legs connected by two 2-in. by 1-in. rails, as at A and B in Fig. 18. The latter portions could be a little long rails as at C and D in Fig. 15, similar in size to the previous ones and tenoned into the legs in precisely the same way, the mitred ends meeting those of the shorter rails as shown in Fig. 19. Before the long top rails are fixed, the shelf (Figs. 15, 16 and 17) should be prepared from $\frac{3}{4}$-in. stuff. It is 11 in. by 3 ft. 8 in., notched to fit against each leg as at E in Fig. 20, and can probably be obtained in one width. The tenons of the rails can be pegged, screwed, or wedged, and the shelf fixed from below by means of screws

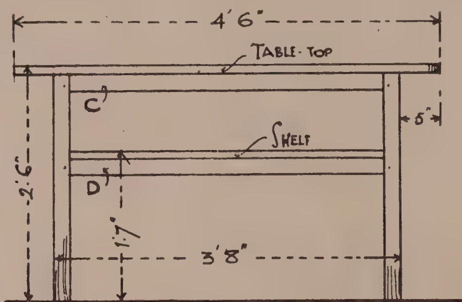


Fig. 15.—Front Elevation of Side-table

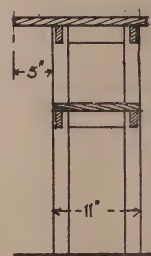


Fig. 17.—Cross Section

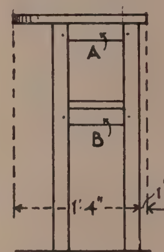


Fig. 18.—End Section

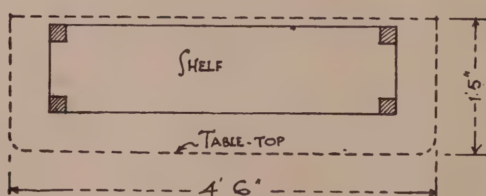


Fig. 16.—Plan at Shelf Level

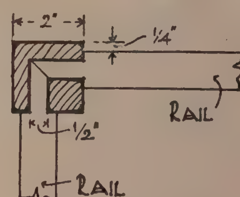


Fig. 19.—Detail Plan of One Leg

thicker if desired, and are intended to have tenons $\frac{1}{2}$ in. thick, mortised into the legs in such a way that the rails will be $\frac{1}{4}$ in. thick back from their outer faces. The tenons are best if mitred ready for the longer rails, as shown on plan in Fig. 19, the joints being further explained by the isometric views in Fig. 20, where it will be observed that the upper tenon has to be "haunched," that is, reduced to one half the height of the rail, in order to leave a secure margin of wood above the mortise at the extreme top of the leg.

The next step should be to prepare four put obliquely through the top inner edges of the rails.

For the table-top two widths dowelled or cross-tongued together will be requisite. It should be out of 1-in. stuff, with its front corners cut to quadrants of about 2-in. radius, and arranged in most cases to overhang 1 in. along the back edge. It can be fixed as before described, or by means of "buttons" fitting in grooves in the rails, allowing for a little expansion or contraction, and it will be advisable to slightly round off all exposed angles.

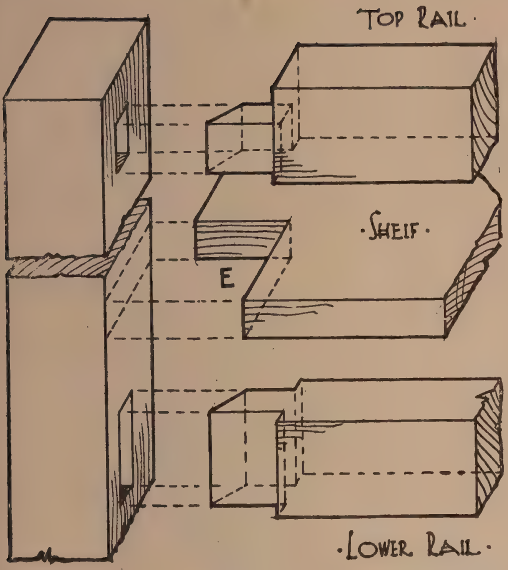


Fig. 20.—Isometric Sketch of Joints of Side-table

Either a clean natural surface, a sized finish, or an application of varnish would be suitable for the type of work; but this matter may be left to individual taste.

DETACHABLE TABLE

The kitchen table shown in Fig. 21 can be taken apart in several sections. The dimensions given are suitable for an ordinary cottage kitchen; but the same construction and dimensions of the several parts are applicable to tables up to 9 ft. by 5 ft. top surface, with the one exception of the legs, which should be increased in size sectionally when the length of the table exceeds 5 ft. Figs. 22, 23 and 24 show side and end elevations and plan respectively.

The top can be made from sycamore, good white deal, or fir, which can be got in 11-in. widths, and should be free from knots, sap, and shakes. White deal or fir is preferable to yellow deal or pine, as it always scrubs clean and white, and does not become discoloured. The wood should be 1 in. thick. A fillet 2 in. by 1 in. is mitred at the angles, and screwed on the underside of the top all round the edges, the joint being broken by a bead worked on the fillet if desired. This not only serves to protect the edges of the top, but gives it a substantial appearance.

The legs may be constructed of white or yellow deal 3 in. square, and they can be turned, or square and tapered as shown. Fig. 28 shows the mortise and dovetail notch to receive the rails. There are four bolts (one in each leg), which should be about 8 in. long and $\frac{3}{8}$ in. to $\frac{1}{4}$ in. in diameter; they should have snap-heads, having a slot cut across them with a file, for the purpose of inserting the blade of a screwdriver when turning them either in or out. The long-side rails are also of deal $6\frac{1}{2}$ in. wide and 1 in. thick, grooved on the inside for the buttons for attachment to the top (*see* Fig. 25); a hardwood cleat (as at A in Figs. 26, 27 and 28) is fitted into a notch, and well

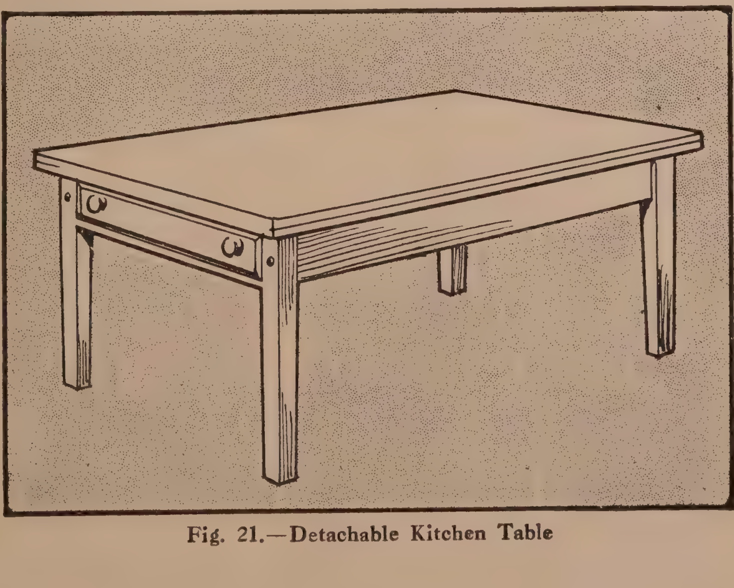


Fig. 21.—Detachable Kitchen Table

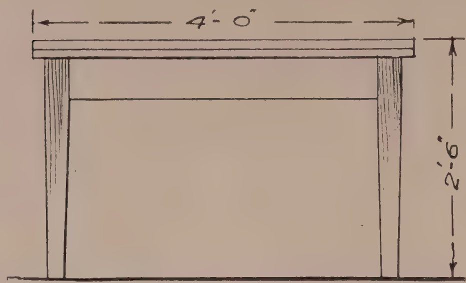


Fig. 22.—Side Elevation of Detachable Table

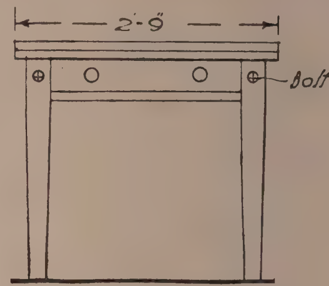


Fig. 23.—End Elevation

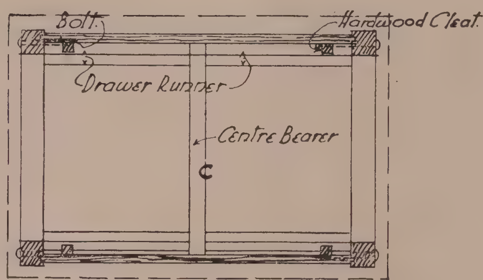


Fig. 24.—Plan without Top

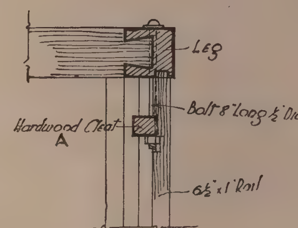


Fig. 27.—Detail Plan of Leg

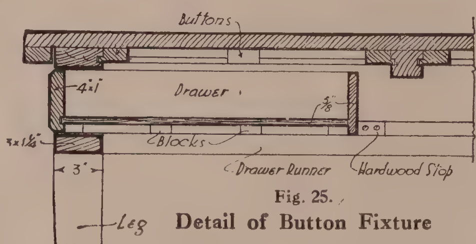


Fig. 25.
Detail of Button Fixture

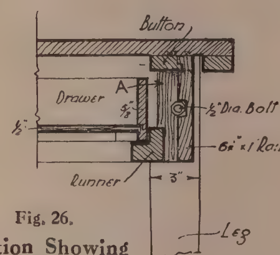


Fig. 26.
Section Showing Cleat

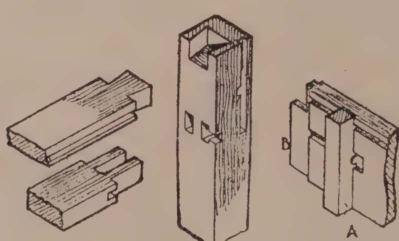


Fig. 28.—Joints of Leg and Rails

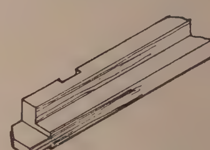
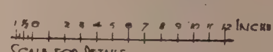


Fig. 29.—Drawer Runner



glued and fixed with screws, a hole being bored through it to accommodate the belt. The tenon at the end B (Fig. 28), which is about $1\frac{1}{4}$ in. long by $\frac{5}{8}$ in., should fit easily into the leg. The upper cross-rail is ploughed on the inside for buttons, and is dovetailed to drive into the top of the legs ; the lower rail has two tenons about $2\frac{1}{2}$ in. long by $\frac{3}{8}$ in., which should be secured permanently to the legs by well gluing ; they are made of deal 3 in. wide by $1\frac{1}{4}$ in. thick (*see* Fig. 28).

The centre bearer C (Fig. 24) is about 1 in., with lips to fit into grooves in rails ; they should be secured to the top with stout brass screws to prevent rusting in, which would occur if iron were used. The side rails should be fitted into their respective legs, and marked by cutting with a chisel Roman numbers on the inside to correspond, and the holes for the bolts should now be bored.

All that is necessary in taking the table apart is to slack the screws with a screwdriver, and, turning the buttons round, disengage them from the rails, lift off the

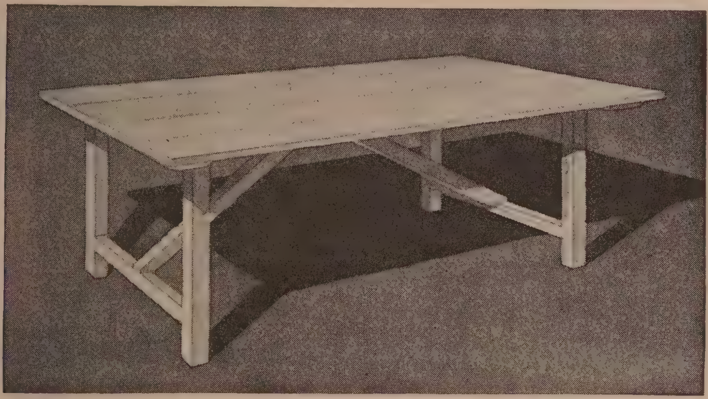


Fig. 30.—Perspective View of Simple Table

2 in. by $1\frac{3}{4}$ in. in section, and has a lip tenon to fit into a mortise in the long rails at the middle of their lengths, and should be grooved for buttons. The drawer-runners are 2 in. by 2 in. in section, and are rebated to form a guide for the drawers (Fig. 26) ; they are notched to fit over the cleat for the bolt (*see* Fig. 29). A hardwood drawer stop, about $\frac{3}{4}$ in. by 1 in., is screwed into the rebate, as shown in Fig. 25. The front of the drawer measures 4 in. by 1 in., each side 4 in. by $\frac{5}{8}$ in., and the back 3 in. by $\frac{5}{8}$ in. ; they are dovetailed together. The bottom is $\frac{1}{2}$ in. thick, and fitted into grooves in the front and sides, and nailed on to the back. The sides and front should be secured to the bottom by glued blocks underneath, as shown in Figs. 25 and 26, and the buttons should be of hardwood, 4 in. long by $1\frac{1}{2}$ in. by top, take out the bolts, and draw off the united pairs of legs at the ends, leaving the long rails, centre bearer, and runners in separate pieces. The reverse method is adopted in re-erecting the table.

SIMPLE TABLE

This table (Figs. 30 to 33), while unusual in construction, combines the advantages of strength, lightness, and economy of material with that of being easily separated into several portions convenient for storage or transit. It is perfectly suited for kitchen and other purposes.

The dimensions given in the following list are approximately those of parts worked ready for fitting together. The top measures 6 ft. by 3 ft. 3 in. and 1 in. thick, composed of any convenient number (probably four) of widths ; these should

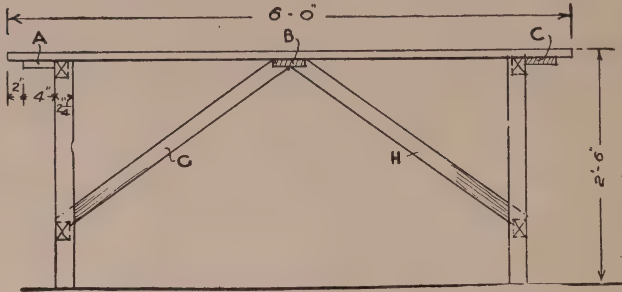


Fig. 31.—Front Elevation of Simple Table

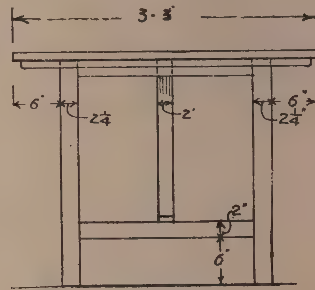


Fig. 32.—End Elevation

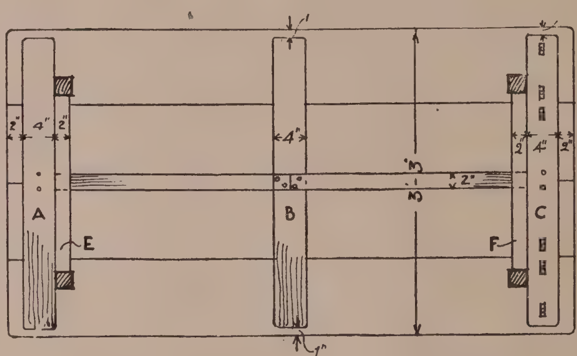


Fig. 33.—Underneath Plan of Simple Table

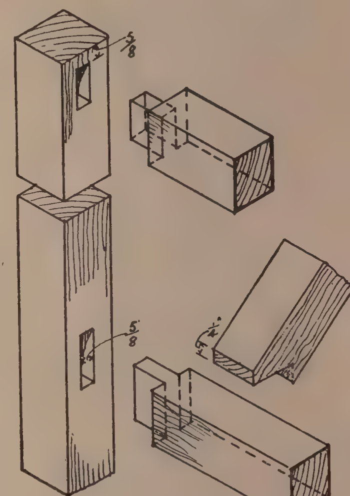


Fig. 34.—Details of Joints

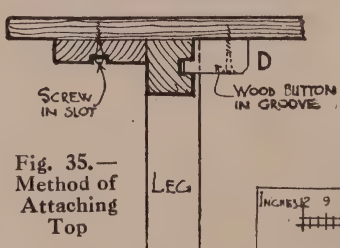


Fig. 35.—Method of Attaching Top

be joined up with oak cross-tongueing, and have three 4-in. by 1-in. ledges, as A, B and C in Figs. 31 and 33. These ledges should be slot screwed except in the centre of their lengths, in order to allow a slight movement without splitting. For the under-framing, four legs $2\frac{1}{4}$ in. square and 2 ft. 5 in. long; four rails about $2\frac{1}{4}$ in. by 2 in. and 2 ft. $1\frac{1}{2}$ in. long; two struts about 2 in. by 2 in. and 3 ft. long; six or eight "buttons," as D (Fig. 35), about 3 in. by $1\frac{1}{2}$ in. by 2 in.

The top has already been sufficiently described so that the next part to require mention will be one of the two end framings. It is set out and dimensioned in Figs. 31 to 33, and the two rails should be fixed flush with the outer faces of the legs. They are fixed by means of tenons $\frac{5}{8}$ in. thick and mortised about $1\frac{1}{2}$ in. into the legs, the upper joint being "shouldered" or kept down about $\frac{5}{8}$ in. from the actual top surface of the leg as shown (Fig. 34), while the tenon of the lower one is of the same depth as the rail. When ready, the

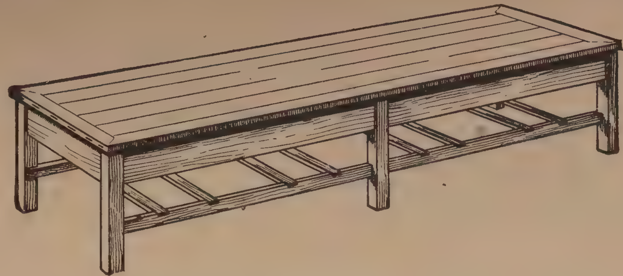


Fig. 36.—Perspective View of Laundry Table

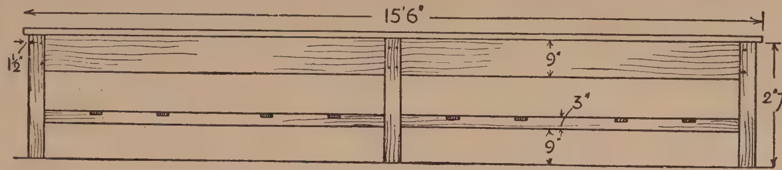


Fig. 37.—Elevation of Laundry Table

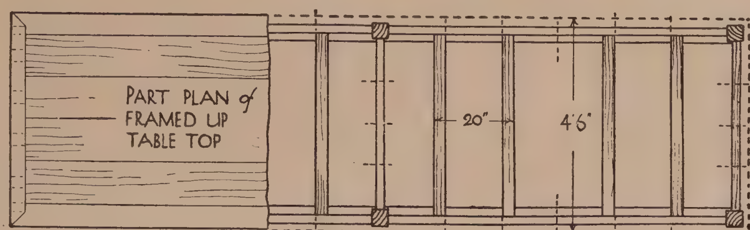
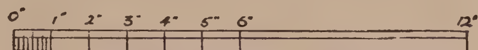


Fig. 38.—Part Plan of Laundry Table Framework



Scale for Details

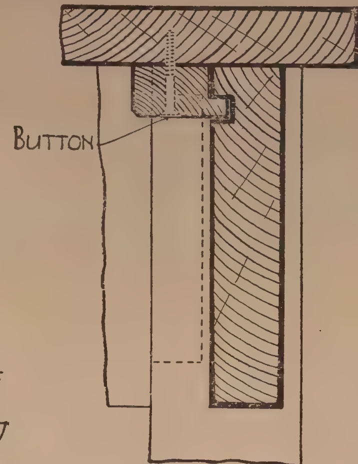


Fig. 43.—Method of Attaching Top

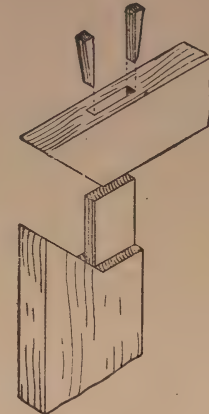


Fig. 40.—Detail of Top, showing Wedging

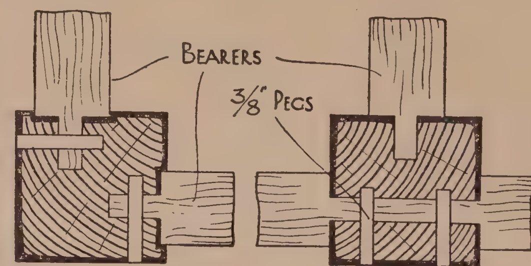


Fig. 41.—Details of Corner Leg

Fig. 42.—Detail of Centre Leg

Fig. 39.—Fnlarged Section of Top

top should be reversed and laid flat, the end framings placed in position as at E and F in Fig. 33, tight up against the end ledges of the top, held there with one good screw near the centre of each top rail, and then secured with "buttons," as at D in Fig. 35, fitting a groove in the side of the top rail and screwed through to the boarding.

This done, the table will be comparatively strong but lacking rigidity, which is imparted to it by the addition of struts, as at G and H in Fig. 31. Each of these should be of full length, birds-mouthed to fit the lower rail and the central ledge, and secured to each with two $2\frac{1}{2}$-in. screws, thus producing a perfectly firm table.

IRONING TABLE FOR LAUNDRY

The illustration (Fig. 36) shows a good ironing table suitable for a laundry. An elevation is shown in Fig. 37 and a plan of the framework with the top removed is given in Fig. 38.

The timber generally, except the table-top, should be of the best yellow deal free from large knots or defects, and thoroughly seasoned. All joints should be well made and put together, where possible, with oak pins, thus avoiding the use of nails. The top is of $1\frac{1}{2}$-in. white deal tongued-and-grooved battens (*see* Fig. 39) framed together as shown in Figs. 36 and 40, the end tenons being wedged up tightly. The legs are 4 in. by 4 in., grooved for the rails, as shown in Fig. 41, while the rails are 9 in. by 2 in. The side rails are in one length, and checked out to fit the top of the centre leg and pinned (*see* Fig. 42). The cross-rail in the centre of the table is of 9-in. by 2-in. stuff, with a tenon formed on each end for two-thirds of its depth, to fit the top of the centre leg, as shown in Fig. 43. Plough-goove the rails all round for twenty-nine hardwood buttons, placed as indicated by broken lines in Fig. 38. These buttons are fixed with brass screws, as shown in Fig. 43.

The racks underneath for linen baskets are formed of 3-in. by 2-in. rails halved on to legs, and 3-in. by 1-in. bearers fixed 1 ft. 2 in. apart. All the edges should be arrised.

Domestic Woodware

BATH SEAT

To make a bath seat as shown in Fig. 1 procure a piece of teak $1\frac{1}{16}$ in. thick, from which the following sizes can be cut: Two pieces $8\frac{1}{2}$ in. by $8\frac{1}{4}$ in.; seven pieces $15\frac{1}{2}$ in. by $1\frac{3}{8}$ in.; and four pieces 5 in. by $1\frac{1}{8}$ in. Two pieces of brass are also required, each 7 in. long, $\frac{3}{8}$ in. wide, and $\frac{3}{16}$ in. thick.

Proceed now with the planing of each piece to the finished size shown in Figs. 2 and 4, being careful to have all the edges squared to ensure accurate work when setting out the mortise-and-tenon joints. The length of the spars for the seat should now be set out, and the position of the tenons marked off. The same operations should be carried out with the four hangers, and then it is possible for the cutting of all tenon joints to be done at the one time. Next proceed with the cutting of the shoulders and the ripping of the tenons. Then the position of the mortises can be marked off on the side pieces. This part should be most carefully done, as the proper working of the seat depends entirely on each spar being its exact distance apart.

The mortises should now be cut out, after which the side pieces should be cut to the tapered outline given in Fig. 4, the corners rounded, and the face arris chamfered as in Fig. 5, where the parts are shown ready for fixing together. Then plane the hanger to a round section. This is best done by taking the corner off first to form an octagon, and then by easy stages converting the polygonal figure into a complete circle. The position of the long $\frac{3}{16}$-in. slot in each of the spars (*see* Figs. 2 and 4) should now be set out, care being taken that all the gauging is done

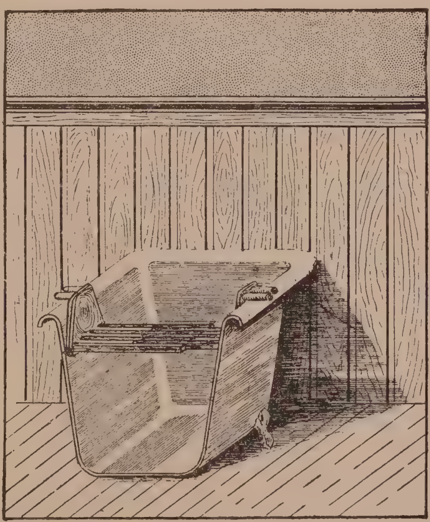


Fig. 1.—View of Bath Seat

from the one side. To cut out the slots, the simplest plan is to bore a number of holes at the one end, sufficient to allow a port saw to pass through. Then a saw-cut can be made for the remainder of the work, and the slot pared out from both sides to the gauge marks with a chisel.

The spars are now ready for rounding so as to form a comfortable seat, and can be bored for fixing to brass bearing plates. All the pieces should now be carefully planed with the smoothing plane, and the surfaces finished with glasspaper. To put the seat together, glue and wedge the tenon joints together, putting four spars into the one side piece and three into the other. The ends of tenons should now be pared off, and the surfaces finished.

Next set out the holes on the brass plates (Fig. 6), and if there is any difficulty in the boring, this could be done by a local smith. The seat is now ready to be fixed together, and to do so put the spars in position, as shown in Fig. 3, and pass the respective brass plates through the slots into position. The spars should then be secured with brass nails, as shown in Fig. 3, the heads of the nails being left slightly below the surface of the seat. The seat can now be wax-polished, and for this purpose the screws should be taken out of the spars and the polishing carried out with the two parts of the seat separate. By this means all surfaces and edges will be coated with polish.

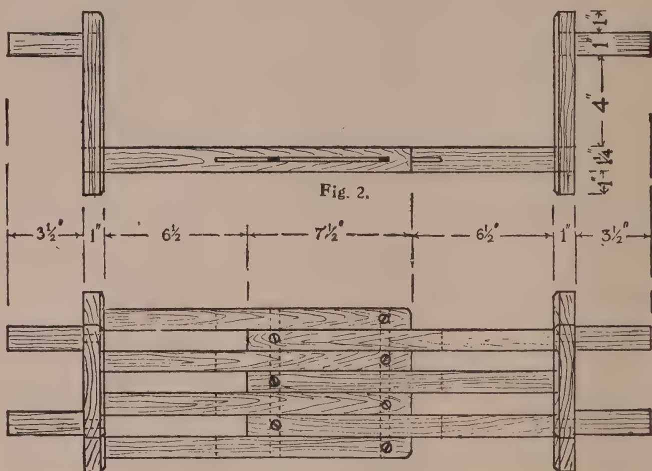


Fig. 2.

Fig. 3.

Figs. 2 and 3.—Front Elevation and Plan of Bath Seat

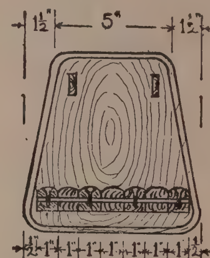


Fig. 4.—Cross Section of Seat

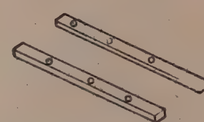


Fig. 6.—Brass Bearing Plates

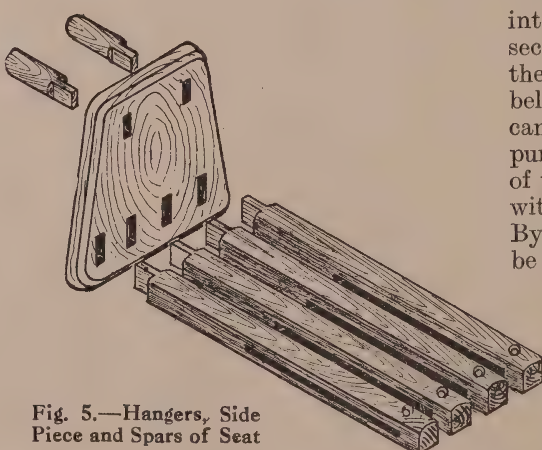


Fig. 5.—Hangers, Side Piece and Spars of Seat

THERMAL BATH CABINET

A thermal bath, sometimes recommended for the cure or alleviation of specific complaints, consists of an enclosure inside which the patient can stand or sit and be surrounded by steam, chemical vapours, or hot dry air, or be exposed to the action of radiant heat in a dry atmosphere. The portable cabinet shown by Fig. 7 consists of a bottom or floor, four sides, and a cover for the top and sloping parts. Such cabinets can be made of sheet metal

or wood; the latter is usually preferred, as it does not conduct heat so readily as metals, which are, however, better for a high temperature, but buckle and twist very much when heated, and this prevents the joints fitting properly unless strengthened with iron plates.

The wood should be light and thoroughly seasoned. All woods swell on being wetted, and shrink on drying; but American whitewood or red pine, or any wood which contains very little resin and is free from knots, can be used. The bottom, or floor, may be 3 ft. by 2 ft. 9 in. by $1\frac{1}{4}$ in. thick, and battened to keep it from warping and twisting. The edges should be rebated all round to receive the bottom edges of the four sides, as shown in Fig. 8; the dotted lines represent oak dowels. The back may be framed and panelled, the stiles and rails being of 1 in. stuff, and the panels $\frac{3}{8}$ in. or $\frac{1}{2}$ in. thick. The frames and panels are best flush inside. Any mouldings on the outsides of the panels should be worked out of the solid stiles; but if they are planted on they should be nailed to the stiles and rails, so as to allow freedom for the panels to expand and shrink. The framing should be pinned together, no parts being glued.

The edge of the back may be fixed to the bottom with dowels, as shown in Fig. 8, the upright edges of the back being rebated for fitting to the side pieces, as in Fig. 9.

At the top of the back a piece of $\frac{3}{4}$ in. stuff (Fig. 10) should be hung on brass butts with gunmetal pins, so as to fold inwards when the cabinet is taken to pieces (see Fig. 11). The ends of the folding top piece should have caps (*see* Fig. 12) to lap over the sides and help to keep them in their positions. The half-circle (*see* Fig. 10) should be to a radius of $2\frac{1}{2}$ in. to 3 in., the edges being carefully rounded to avoid chafing the user's neck.

The sides may be panelled, as shown in Fig. 13, the upright edges being rebated to the back, and secured by a brass staple and hook on brass plates fixed a few inches below the top of the cabinet. The dotted lines in Fig. 7 show the lattice work seat, which should rest on fillets. The seat can be omitted, and a chair used instead; but the seat, if used, should not be painted or varnished. The two halves of the sloping top are to be hung to the sides by brass butts, and have easy fitting rebated joints (*see* Fig. 14) at the top and centre. If these joints are fitted too tight they

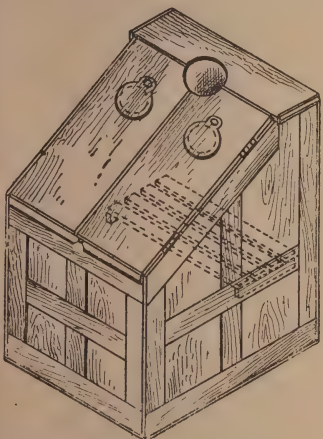


Fig. 7.—Thermal Bath Cabinet

Fig. 8.—Joint at Bottom of Cabinet

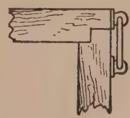


Fig. 9.—Joint at Side of Cabinet

Fig. 10.—Top Piece

Fig. 11.—Hinged Top Joint

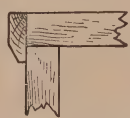


Fig. 12.—Lap Joint

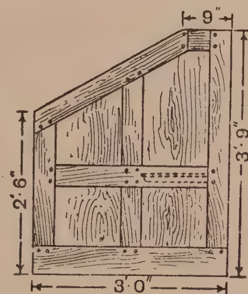


Fig. 13.—Panelled Side of Cabinet

Fig. 14.—Rebated Joints to Top Pieces

will probably lock when the three flap pieces are all opened together by the bather rising to get out of the bath. Cappings (as in Fig. 12) may be fixed on the bottom ends of the sloping flaps to lap over the front piece and hold it in position. Corners cut out of the sloping flaps complete the hole for the user's neck and 5 in. holes for the hands must be made in each a few inches lower down. Covers for the hand-holes are made out of $\frac{1}{2}$ in. or $\frac{3}{8}$ in. stuff and turn on hardwood pins with heads. The covers can be fixed inside, and be under the control of the bather.

The front of the cabinet should be panelled similar to the back and sides, and fitted in the same way, except that it should not be fixed or held together with bits or fastenings of any kind, as it is important that the bather should be able to leave the cabinet very quickly if necessary. In the hinged top a special opening may be made for a thermometer to indicate the inside temperature. Wood thermal cabinets should not be painted, but for a finish they can be stained and varnished.

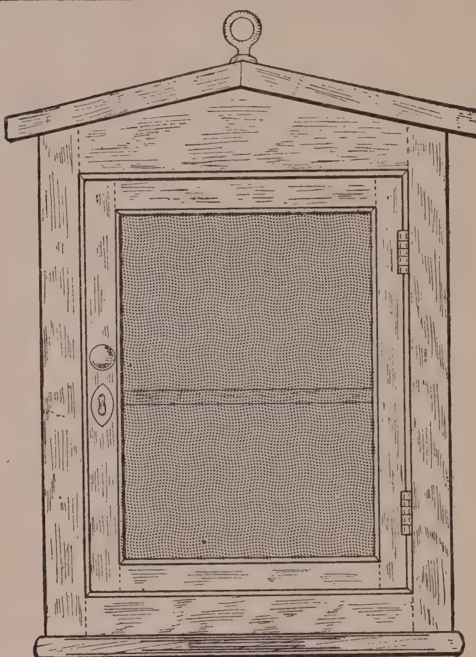


Fig. 15.—Front Elevation of Meat Safe

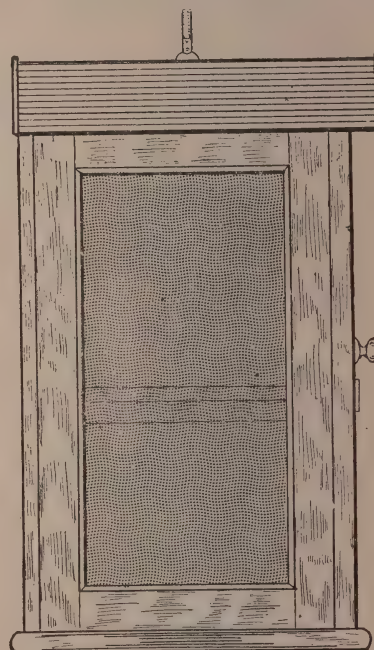


Fig. 16.—Side Elevation of Meat Safe

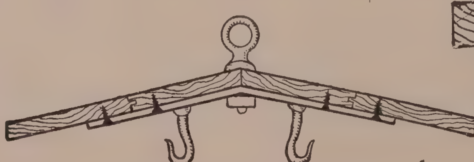


Fig. 17.—Section of Roof

Fig. 19.—Section of Framework

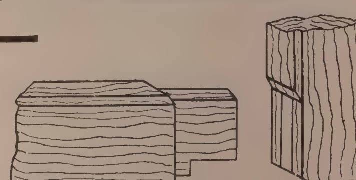


Fig. 18.—Joint for Framework

MEAT SAFE

The meat safe shown at Figs. 15 and 16 can be made of deal. It is fitted with

a shelf which divides it into two compartments, the upper one being fitted with hooks at the top, as shown in Fig. 17. The sides and front are covered with perforated zinc, which allows of a free passage of air.

The general dimensions are: width, 1 ft. 6 in.; depth, back to front, 1 ft. 3 in.; height to underneath side of the roof, 2 ft.; rise of roof in the middle, 2 in. The framework of the front and side frames is 2 in. by $\frac{7}{8}$ in., mortised and tenoned together as at Fig. 18. The back is $\frac{5}{8}$ in. thick, and the bottom $\frac{7}{8}$ in. thick. The framework of the door, $1\frac{1}{2}$ in. by $\frac{7}{8}$ in., mortised and tenoned together, is hung with two 2-in. butt hinges and is fitted with a lock and key. The framework of the front door and side frames is boxed out on its inside edge $\frac{3}{8}$ in. by $\frac{1}{2}$ in. to receive the perforated zinc, which is fixed in position by fillet pieces, as shown at Fig. 19. The roof is $\frac{7}{8}$ in. thick, and should be covered with zinc to prevent water penetrating into the inside of the safe. The hooks in the top are of $\frac{3}{8}$-in. round iron riveted into a 1-in. by $\frac{1}{4}$-in. iron plate. The safe is hung by means of an eye bolt, which has a $\frac{3}{8}$-in. spill through the roof fixed with a nut underneath.

PROVISION SAFE

The safe illustrated by Figs. 20 to 22 can be built up of stuff 2 in. or $1\frac{1}{2}$ in. square to the sizes shown, the joints being simple tenons of the usual character.

It will be noted that the ends have a middle horizontal rail A (Fig. 21) not present on the back. This serves to support the shelf. For the top, $\frac{3}{4}$-in. tongued boarding projecting $\frac{1}{2}$ in. all round will suit, while the 1-in. bottom is supported by the four bottom rails, as at B in Fig. 22. The doors are formed of 3-in. by 1-in. stuff halved at the angles, rebated, and beaded down the meeting stiles, and without rebates on the inner edges, the wire panels to these and also to the sides and back being secured by means of a double bead all round. Only a single bead on the outside will be required at the sides against the edges at the bottom and middle shelf. A single bead also at the head, together with the edge of the bottom shelf,

Fig. 20.—Front Elevation of Provision Safe

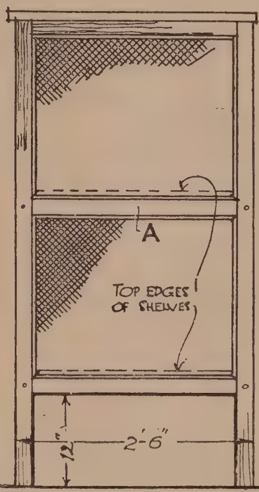


Fig. 21.—Side Elevation of Provision Safe

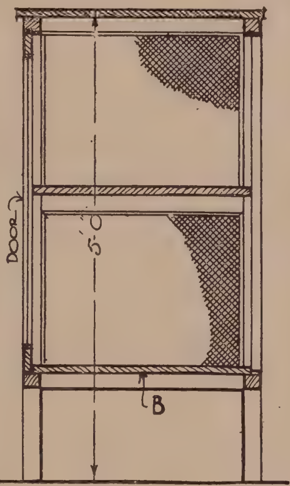


Fig. 22.—Section of Provision Safe through Centre

will serve as stops for the doors, as in Fig. 22.

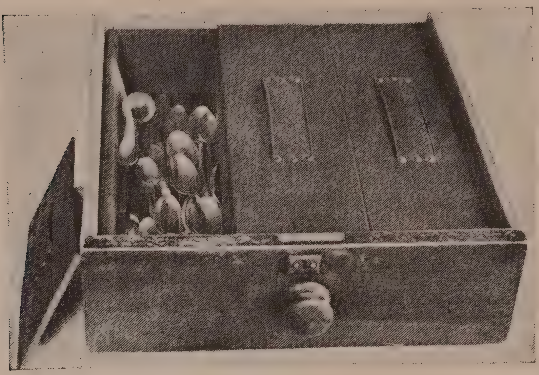


Fig. 23.—Fitment for Cutlery Drawer

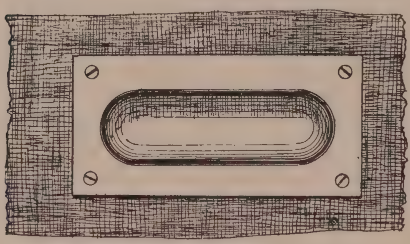


Fig. 25.—Flush Handle

TARNISH-PROOF FITMENT FOR CUTLERY DRAWER

The fitment and drawer are shown by the photographic reproductions (Figs. 23 and 24).

The drawer in this case is about 18 in. square by 6 in. deep, and the fitment is intended to serve the purpose of a knife-box, to be lifted out with the contents as required. Because of this, two finger-place handles, the same as used for sliding doors (*see* Fig. 25), are let flush into the outer sides of the two partitions of the fitment. Also, to allow for the drawer to be pulled out to the full extent and no farther, a stop is put at the upper edge of the drawer back to come against the inside edge of the front bearer rail of the drawer place. This latter is about 2 in. wide, and it happens that there is a space of about $2\frac{1}{2}$ in. between the back of the recess and the drawer when closed. Thus it allows for the stop to be made of a piece the length of the drawer back by 2 in. wide by $\frac{7}{8}$ in. thick, with a strip of beading $1\frac{1}{4}$ in. by $\frac{3}{8}$ in. screwed on one edge. This stop is fixed with three screws through the drawer back (*see* Fig. 26) ; but these screws must be slacked to allow the stop to drop a little to put the drawer in place and then tighten up.

The fitment is made 4 in. deep, the space between the bottom and the drawer bottom being used as a press for the table linen, which is another convenience. It consists

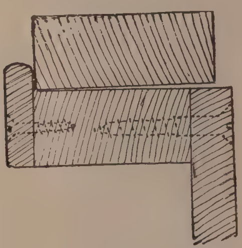


Fig. 26.—Drawer Stop

of a box made in common deal $\frac{1}{2}$ in. thick, with two partitions, and a bottom of three-ply or other thin board. It should fit easily, but neatly, into the drawer, allowing for the felt with which the wood is to be covered. The box is first

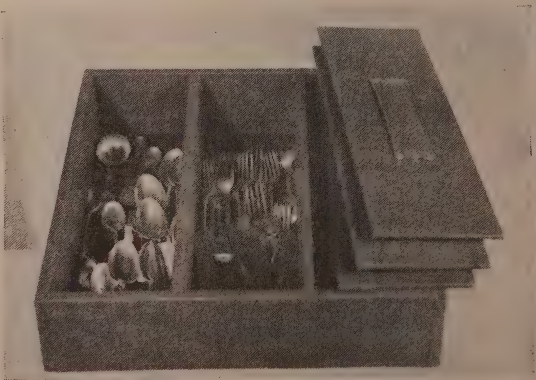


Fig. 24.—View showing Fitment Open

made and put together with screws—$1\frac{1}{4}$ in. No. 4 for the sides and $\frac{5}{8}$ in. No. 4 for the bottom. The handles may be fitted into the partitions. It is then taken apart for covering with green felt. The bottom is to be covered on the inside only, fixed with glue applied to the board just sufficient to fix the felt, taking care to have it the right consistency so as not to work through.

The two partitions are covered on both handles of the same material fixed with nickel-headed stud nails. Before putting into use, the fitment should be allowed several days in dry air to make sure that all moisture has evaporated.

EASILY-MADE SMOKER'S CABINET

This small hanging cabinet can be of $\frac{1}{2}$-in. stuff throughout, oak or mahogany

Fig. 27.—Easily-made Smoker's Cabinet

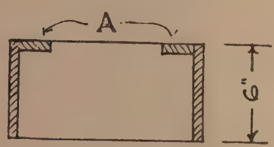


Fig. 28.—Plan of Lower Part of Cabinet

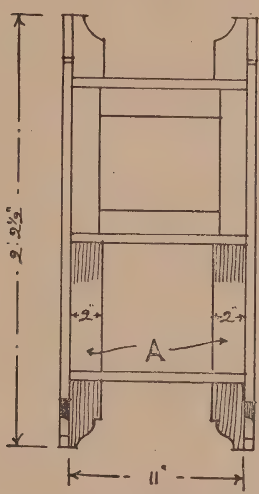


Fig. 29.—Front Elevation of Smoker's Cabinet

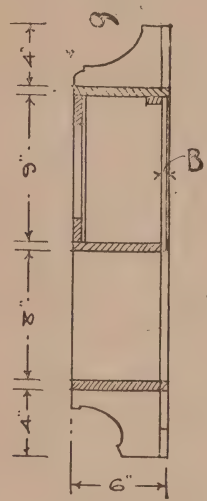


Fig. 30.—Section of Cabinet through Centre

sides over the top edge, the felt edges meeting under the lower edge of the wood. The felt for the four box-sides should be cut to cover both sides and edges, allowing fully $\frac{1}{2}$ in. over at the ends of the two longer pieces, also about $\frac{1}{2}$ in. to lap under the bottom. It must be fixed first on the inner sides and lower edges only; then the parts must be screwed together and the felt glued over the outer sides. There are three lids of three-ply wood, each covered all over with the felt, having flat for preference. Its upright portions comprise two sides of the dimensions given, shaped top and bottom to some such contours as those in the illustrations, and a couple of uprights as at A in Figs. 28 and 29, these latter serving to tie the sides and shelves together. The top and bottom shelves are of the same width as the sides, into which they should be stop-housed, and they should be notched out at their back corners to fit the uprights A, which are also shaped top and bottom. For

the central shelf a piece $5\frac{1}{2}$ in. wide should be used, so that in this case the notching just mentioned will not be required. The uprights A are nailed or screwed to both sides and shelves, and for a good job it would be desirable slightly to rebate the sides to take them neatly, instead of having simply a butt joint, although this is not essential.

The back of the cupboard can be filled in with three-ply or other thin form of panels, and should be fixed to the back of the middle shelf and to a fillet along the underside of the top shelf, as shown at B in Fig. 30. The fillet might with advantage be continued down the inner sides of the cupboard, which can be fitted up with a shelf, pipe-racks, or compartments as desired. The door can be panelled, or built up with good three-ply having sham framing applied on its face. To add a touch of interest the panel may well be decorated in some way best suited to the craftsman. A simple conventional device, such as the rising sun shown in Fig. 27, can very easily be carried out in gesso, repoussé, leaded glazing, or painted ornament; or a framed and glazed picture might be incorporated.

HANGING CLOTHES AIRER

Three views of the clothes airer are given in the illustrations, Fig. 31 being a side elevation, Fig. 32 a plan, and Fig. 33 an end elevation.

The two 10-ft. runners A are each made up of three pieces, two 3 ft. $4\frac{1}{2}$ in. by $2\frac{1}{2}$ in. by $\frac{3}{4}$ in., and one 3 ft. 3 in. by $2\frac{1}{2}$ in. by $\frac{3}{4}$ in.; these are joined together with strong brass bagatelle-table or desk hinges, as shown at B, care being taken that the hinges are fixed on opposite edges of the runner so that one end folds over the top and the other underneath. An enlarged detail of the hinged joint is shown at Fig. 34. Opposite one hinge on each runner must be screwed a brass plate 5 in. by $\frac{3}{4}$ in. by $\frac{1}{8}$ in., as shown at C, to keep the whole in perfect alignment. These plates must be removed when the airer is to be folded. The brass plates will not be required if the method of jointing shown at Fig. 35 is adopted. A cheaper and easier method of making the joints of the runners is shown at Fig. 35. The pieces are halved together, and fixed with six brass countersunk head whitworth screws and nuts. This makes a good strong job; but the dimensions given above will have to be slightly modified.

The over-all length of the hanging rods is 2 ft. $5\frac{1}{2}$ in., four of them being $\frac{7}{8}$ in. in diameter, and the remaining fifteen $\frac{5}{8}$ in. in diameter. The large ones are shouldered down to $\frac{3}{8}$ in. in diameter, which is the size all the holes should be drilled, by $\frac{9}{16}$ in. deep, and the small ones tapered for 1 in. down to $\frac{3}{8}$ in. in diameter at the end; and if made of softwood, will be found to be a good driving fit in the $\frac{3}{8}$-in. hole. The rods are afterwards fixed with $1\frac{1}{2}$-in. brass nails. Four strong screw eyes will be required and two single and one double screw pulleys, $1\frac{1}{2}$ in. in diameter, with 12 yards of thick blind cord. The airer folds up to 3 ft. $4\frac{1}{2}$ in. by 2 ft. 6 in. by $7\frac{1}{2}$ in., and weighs only about 9 lb. A coat of size and clear spirit varnish will improve its appearance.

BABY'S PLAY-PEN

The pen shown in the photographs, Figs. 36 and 37, is 2 ft. 6 in. high, which is higher than usually made, and the gate is quite an unusual feature, to save having to stride over it in the event of a child having to be reached quickly. Another point is the wide rail or plinth which comes down to the floor and so prevents toys from getting pushed underneath; this is further improved by fixing rubber draught-proofing on the lower edge. It folds up, as shown by Fig. 38, in a different way from other kinds. The size is 4 ft. 6 in. square.

The wood used is whitewood, except the top rails and the gate fastening piece, which is of birch. The lower rails are 5 in. wide, and the top rails 2 in. by $\frac{7}{8}$ in., the rounded bars being $\frac{5}{8}$ in. in diameter. These latter can sometimes be bought in hardwood, ready made, in lengths of about 3 ft. Each frame may be made the same, with eleven bars, equally dividing

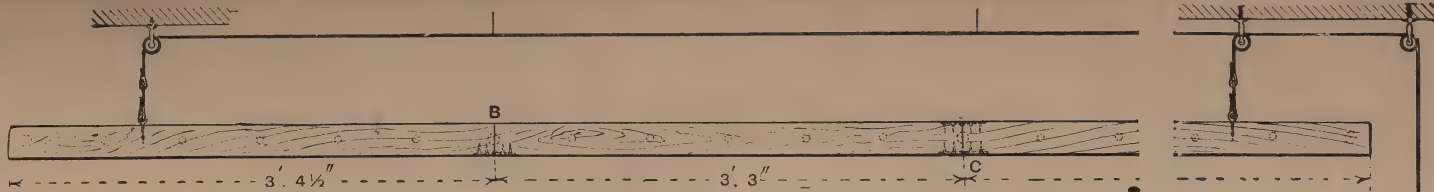


Fig. 31.

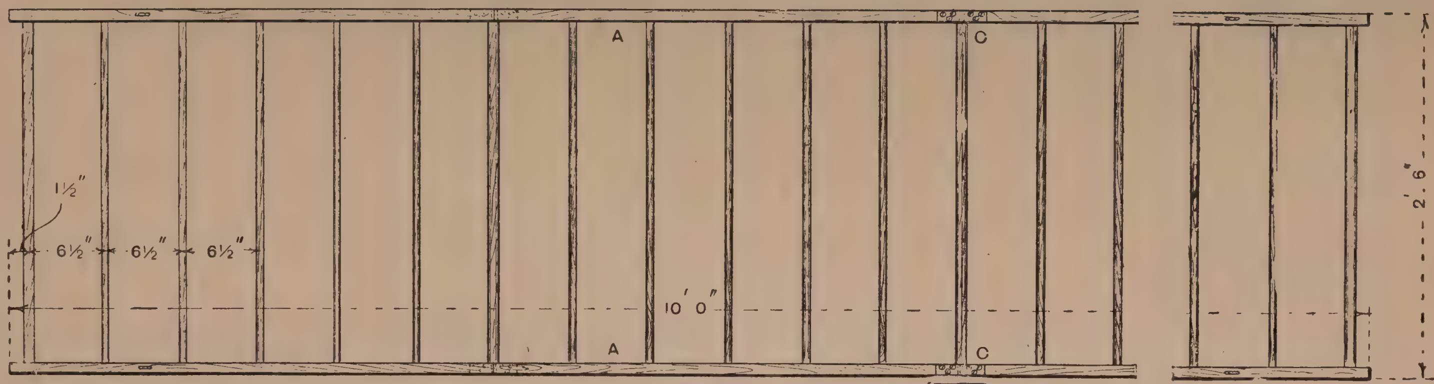


Fig. 32

Figs. 31 and 32.—Elevation and Plan of Clothes Airer

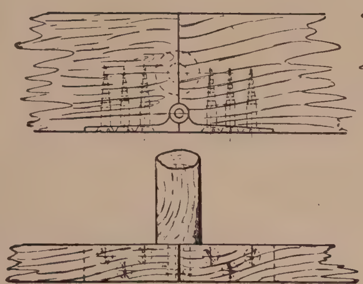


Fig. 34.—Enlarged Detail of Hinged Joint

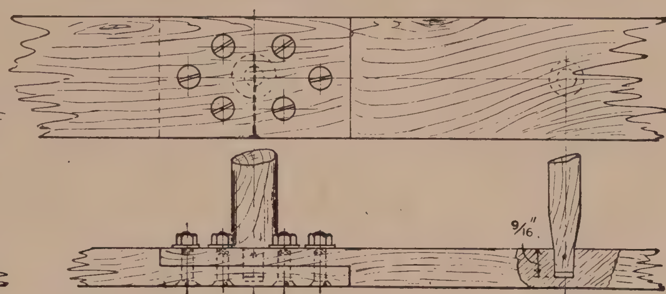


Fig. 35.—Alternative Method of Jointing Runners

Fig. 33.—End Elevation of Clothes Airer

the space with a pair of compasses to decide the points on the rails where the bars must be let in direct about 1 in. deep. This is shown in Figs. 39 and 40, in which will be seen the shape of the top rails, the upper edge being made round, and the lower corners also rounded off. All square corners should be rounded off. In boring the holes for the bars, a clean-cutting twist- or centre-bit should be used, and it is

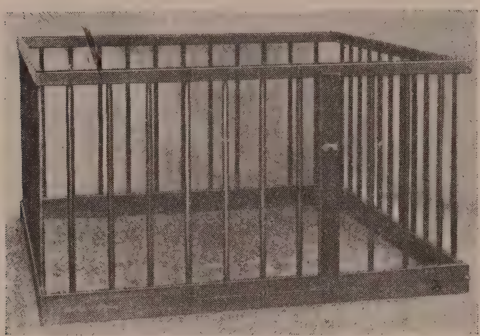


Fig. 36.—Baby's Play-pen

Fig. 37.—Play-pen with Gate Open

essential to keep square with the rail. When all are ready they may be quickly glued up, making certain that they are quite straight and square before being left to set.

The metal fittings required are: three pairs of common iron hinges (Fig. 41), one pair (Fig. 42), two thumbscrew fasteners (Fig. 43), two screw-eyes (Fig. 44), a snap-latch (Fig. 44), and a plate catch for same (Fig. 45). It is sometimes not so easy to get these things exactly as required ready made, so one had to adapt the nearest obtainable. There should be no trouble about the hinges (Fig. 41), but with Fig. 42 something slightly different might have to be used, or a pair could be altered or made at a small extra cost. Figs. 43 and 44 are stock articles, also Fig. 45, in different shapes and sizes. The plate catch (Fig. 46) is made from a piece of sheet brass sufficiently pliable to work, but hard enough to keep rigid. Fig. 45 shows the inner side of the latch, the outside being shown in Fig. 47.

In Fig. 48 is shown the method of hinging the frames together and fixing with the thumbscrew fasteners. The four hinges (Fig. 41) are screwed on the inner sides of the rails as at A (Fig. 48), but they may be let in level if desired. The two hinges (Fig. 42) are put on the outer sides of the rails, and should be let in, as shown at B. Also, they have to be reversed, the inner side out; therefore it is necessary to countersink the screw holes at the other side. The fasteners must have the screw plate let into the ends of the two rails, the plain plate being let into the outer side of the other rails for the thumbscrew heads to tighten up against.

The place for the gate may then be marked for cutting out. This is on the same frame as the thumbscrews. The top rail has to be cut through just a little inside the fourth bar from each end and the lower rail the same, but only half-way through the width. Before cutting the rails, the hinges may be put on the inner side of the rails, let in level, and screwed. They have to be taken off, of course, to cut the rails; but on being replaced the gate will fit true without any further fitting (see Fig. 49). The closing ends should be cut on the slant, as shown in Fig. 50, which also shows the method of hinging the clamp (to carry the snap-latch) with the screw-eyes and screws. Fig. 51 shows how the snap-latch and catch are fitted.

To close up the play-pen, the thumbscrews must be taken out, and these two frames closed inwards; then the two pairs of frames thus formed can be closed outwards, that is, to bring the two outer sides together. The top rails should

Fig. 38.—Play-pen Folded Up

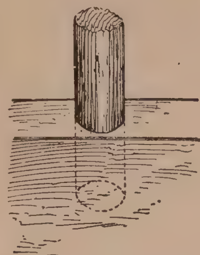


Fig. 39.—Method of Fitting Bars into Rails

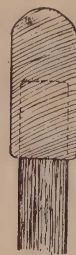


Fig. 40.—Section through Upper Rail

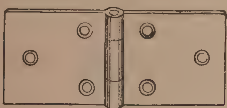


Fig. 41.

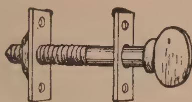


Fig. 43.

Fig. 44.

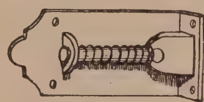


Fig. 45.

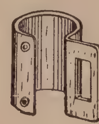


Fig. 46.

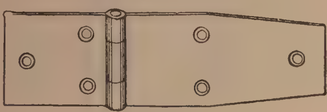


Fig. 42.

Figs. 41 to 46.—Metal Fittings

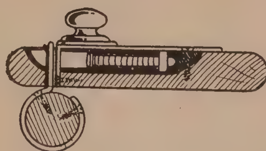


Fig. 51.—Section through Clamp and Bar at Latch

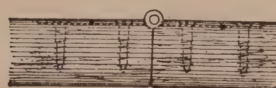


Fig. 49.—Method of Hinging Gate

Fig. 52.—Plan of Pen Folded Up

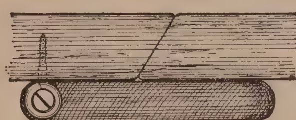


Fig. 50.—Plan of Portion of Upper Rail and Hinged Clamp at Closing of Gate

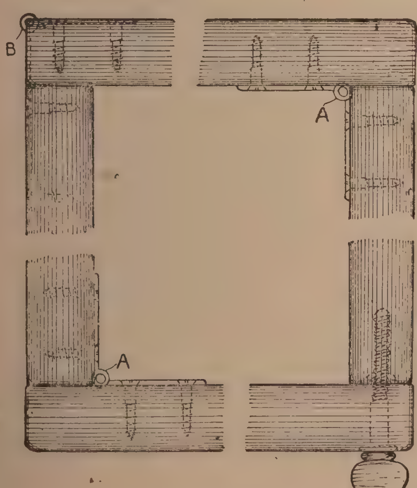


Fig. 48.—Showing Method of Hinging and Fixing Frames Together

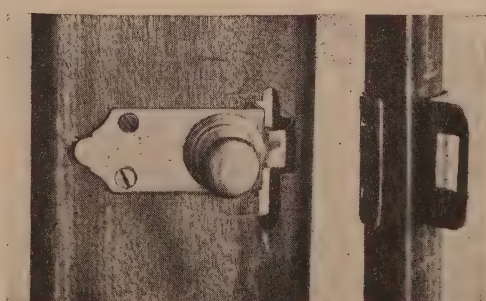


Fig. 47.—Photograph of Snap-latch and Catch Fixed in Position

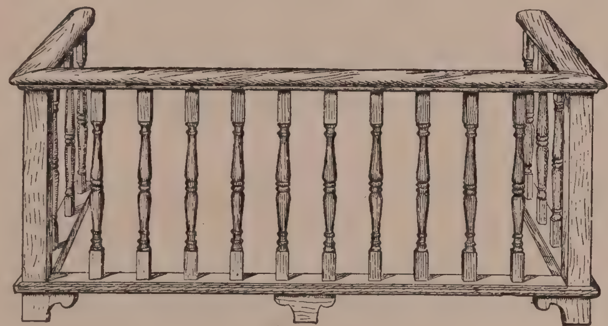


Fig. 53.—General View of Guard

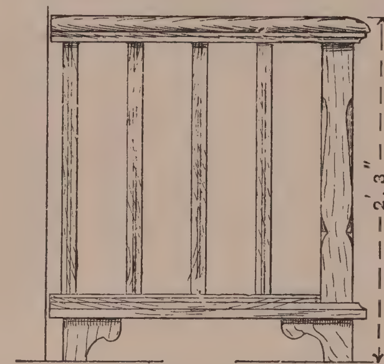


Fig. 55.—Alternative Design for Side

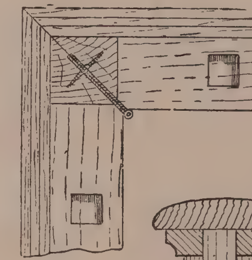


Fig. 61.—Detail of Hinging at Mitre

Fig. 54.—Plan of Guard Folded

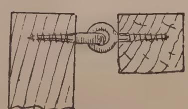


Fig. 63.

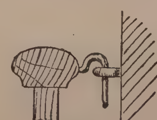


Fig. 64.

Figs. 63 and 64.—Attaching Guard to Mantelpiece

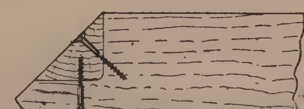


Fig. 59.—Securing Corner Post to Rail

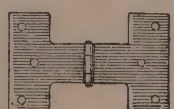


Fig. 60.—Hinge

Fig. 62.—Hooking Side to Front

Fig. 56.—Section of Baluster

Fig. 57.—Enlarged View of Corner Post

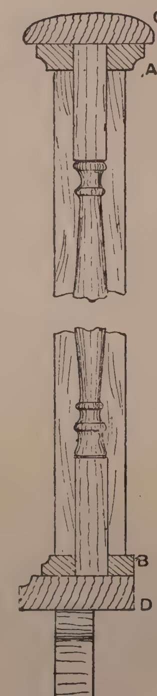


Fig. 58.—Enlarged Vertical Section

present the appearance shown by Fig. 52. The woodwork can be finished with french polish and spirit varnish.

FOLDING FIRE-GUARD IN WOOD

Although wood does not seem an ideal material for a fire-guard, yet by keeping to the dimensions given in the accompanying illustrations, the fire-guard will be a sufficient distance from the fire to avoid any danger from overheating. Fig. 53 is a general view of the guard, while Fig. 54 is a plan showing the side fences folded and hooked to the front rail of the fence. In Fig. 55 is given an elevation of the end fences, showing an alternative design. In Fig. 53 ordinary turned stair balusters are shown in conjunction with plain corner posts of stuff 2 in. square, while in Fig. 55 straight balusters 1 in. square in section and centre reeded, as shown in Fig. 56, are used; the corner posts are chamfered as indicated in Fig. 57, giving them a unique appearance.

Begin with the corner posts, cutting them 1 ft. 10 in. long from stuff to finish 2 in. square; next saw them through the diagonal longitudinally. Also prepare two lengths 4 ft. 6 in. long by $2\frac{3}{4}$ in. wide and $\frac{7}{8}$ in. thick, and four pieces of similar stuff 2 ft. 3 in. long for the sides. These lengths can be cramped together in pairs, marked off, bored, and the holes squared out to receive the balusters, which should fit them fairly tight. These battens are shown at A and B (Fig. 58). When the balusters are in position a capping C and a plinth D are attached to hide the flush ends of the balusters, and also to improve the finish. The half post is housed to the plinth batten D and B, and secured to D with screws, as shown in Fig. 59. The half post is also slightly reduced on its two right-angle faces at the top end, and is then housed to the batten A, while the cap piece C is carried over the top end and mitred, as shown in Fig. 54. The battens have a small cavetto mould worked on their edges; but, in the absence of a suitable moulding plane, an ordinary chamfer would do as well.

The two side fences are next treated in a similar way. The mitres should be adjusted to make the side fences lie at right angles with the front. Two pairs of special hinges (*see* Fig. 60) will be required. They are recessed to and screwed to the halves of the posts. The rivet of the hinge should stand out just clear of the inner angle of the top capping; the lower hinge should also be fixed in the same vertical plane with the top hinge, the method of fixing being clearly shown in Fig. 61. The side fences are retained in their folded position by an ordinary brass hook and eye (*see* Fig. 62). At the corner and centre of the plinth are fixed small shaped brackets or feet, 3 in. high by 6 in. long and 1 in. thick. The corner brackets are mitred at their angles of meeting, but are independent of each other in closing.

If the mantelpiece is constructed of wood, the method of attachment by hook and eye, as shown in Figs. 63 and 64, will be effectual. If the mantel is of stone, slate, or cast-iron, then the hook could be attached to the lower rail, and the eye screwed to the skirting boards; or the wall could be plugged to receive the eye, the hook being fixed to the top rail. The guard should be stained, and, when dry, rubbed with linseed oil.

WOODEN CURB FOR A FIREPLACE

The curb shown by Figs. 65 and 66 entails in its construction a certain amount of skill, but not so much that would make it too difficult for anyone who has a fair knowledge of woodwork. Alternate designs are shown in the sections (Figs. 67 and 68), and if desired the bevelled portion of the curb could be ornamented with carving.

The top, front, and bevelled portion are of hardwood $\frac{1}{4}$ in. thick, placed on the body of the curb to give it its design, thus rendering it easier to make than would be the case if it had to be worked out of the solid. The curb being made this way can be of yellow pine or red deal for the body. The latter is made as follows:—Take two pieces of wood, rough sizes, 3 ft. $8\frac{1}{2}$ in. by $4\frac{1}{2}$ in. by $2\frac{1}{8}$ in. respectively,

the first for the front pieces, and the second for the two end pieces; plane and finish to $4\frac{1}{4}$ in. by 2 in. Before proceeding to bevel the pieces it is advisable to make the half-lap joints at the ends of each piece of wood (*see* Fig. 69). The size of the curb is given in Fig. 66; of course, the sizes may be adapted for any fireplace.

Now bevel each piece to the required angle as shown. This can be done best by drawing out full size the section as shown in Fig. 67, taking the measurements from the inside on the top to where the bevel begins on the front edge. Gauge a line along the top and front, join these on the end of each piece of wood, and this will show the amount of waste that is required to be planed off. When this is done, cut the two end pieces from the short piece, and make them the required length. Screw them together temporarily, and when they are true with each other, glue and screw together and work off the end pieces to the bevel of the front piece. The $\frac{1}{4}$-in. pieces of hardwood, oak, walnut, or mahogany, or any other wood to match the furniture of the room, may now be fixed. Put the bevel pieces on the end first, and finish these to the front bevel. Next the front piece, and plane the waste wood off flush to the top and front. Fix on the top pieces, mitre them at the corner, and then add the front and side pieces. In addition to gluing on the $\frac{1}{4}$-in. pieces, it is advisable to fix them with fine sprigs or needle points to make them secure.

To give a nice finish, as well as to protect the wood from the fire, it is necessary to line the inside of the curb with sheet brass or copper, which may be finished in antique repoussé style.

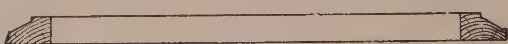


Fig. 65.

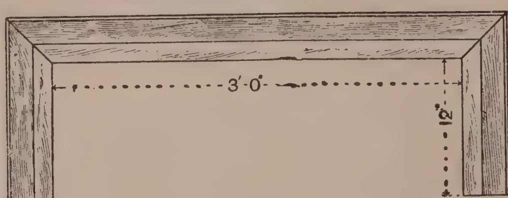


Fig. 66.

Figs. 65 and 66.—Elevation and Plan of Wooden Curb

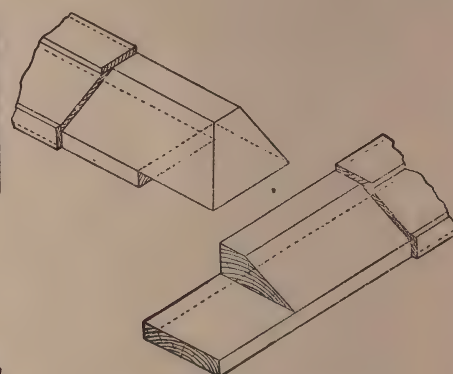


Fig. 69.—Detail of Joint

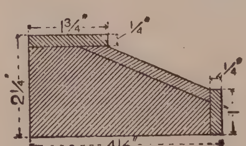


Fig. 67.

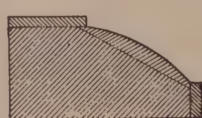


Fig. 68.

Figs. 67 and 68.—Sections of Curbs

BOX PEDESTAL FOR BOOT CLEANING

An article which serves as a receptacle for brushes, etc., and at the same time to rest the foot upon when cleaning a boot is shown by Figs. 70 and 71. It can be made by anyone who is handy with tools, and will be appreciated by members of the household.

The size may be as required; but the one shown is 1 ft. 3 in. high by 1 ft. 2 in. square. A suitable wood is common whitewood of $\frac{7}{8}$-in. thickness, although "spruce shelving" or any other deal boards would do. The whitewood has

Fig. 70.—Box Pedestal for Boot Cleaning

the advantage of being obtainable in wide boards, which saves jointing, besides being more solid than deal and nearly as cheap, and makes a better article. A board 9 ft. long by 1 ft. wide is more than enough, and will allow for working out some of the knots that might be in the board. Two of the sides must be cut 1 ft. 1 in. long, and two $11\frac{1}{4}$ in. long, all 1 ft. wide. When smoothed and squared up they may be nailed together with $2\frac{1}{2}$-in. oval wire nails. It is best to drive one or two nails first straight, to fix them exact, then "skew" the other nails, as in Fig. 72, for which the wood should be pierced with a suitable bradawl. Whilst being nailed, it should be observed that the box is keeping square, and then the nails may be punched a little below the surface.

The bottom will require a 1 in. wide strip nailed on to make it 1 ft. 1 in. square, and it may be secured with 2-in. wire nails, which need not be "skewed" as they do not go into the end-grain wood. The lid is the same as the bottom, but slightly larger, to overhang about $\frac{1}{8}$ in. all round when it is fixed with 2-in. butt hinges. On the edges of the lid a half-round nosing of $1\frac{1}{4}$-in. by $\frac{1}{2}$-in. section, is fixed with nails ($1\frac{1}{2}$-in. ovals); but at the hinged edge it must be no wider than the thickness of the top, as shown at A in Fig. 73, where also is shown the bottom edged with the half-round slips, and the top covered with thick linoleum; but this is not put on until the painting is done. The slips are mitred at the corners and rounded, as in Fig. 74.

In Fig. 73 is also seen drawer knobs put on as feet; also the handles made from pieces of wood 7 in. by $1\frac{1}{2}$ in. by 1 in. They are simply bevelled off at the ends and top edge, and cut out on the under innerside corner as a slot for the fingers (*see* Figs. 75 and 76), and are fixed with a screw and two sprigs at each end. About 4 in. from the top is a loose shelf B (Fig. 73), with a hole in the centre for lifting it out. It rests on triangular blocks fixed at each corner with a screw, as at C. *See also* Fig. 77, which also shows the outer corner well rounded off. The box may be painted green outside and white inside, all the nail holes being filled with putty after the first coat is dry. A piece of plain green thick linoleum is fixed

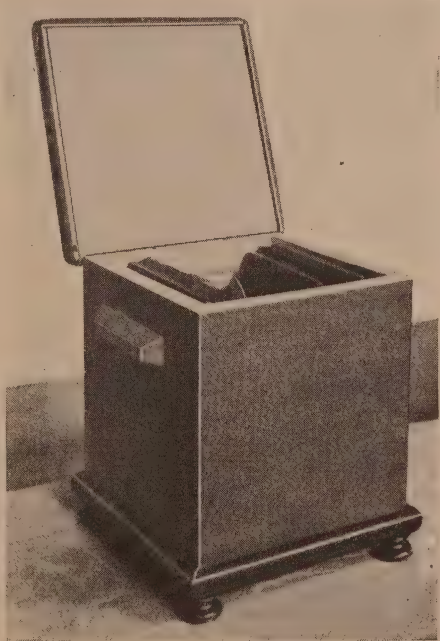


Fig. 71.—Pedestal Open

on after the second coat, with fine wire nails round the edges to fix it down close. Two more coats may be given, going over the linoleum as well, especially round the edges. Plenty of time should be allowed for the paint to get dry and hard.

DUSTLESS CINDER-SIFTER

Fig. 78 shows a dustless sifter which can be easily made and operated, and by the use of which a considerable saving will be effected.

The sifter has an outer box, into which the sifter proper fits and works on two runners screwed to the sides. A cover having overhanging edges fits over the box and the sifter is worked by a handle projecting through the box. The ashes are placed in the sifter, the cover is closed, and a few backward and forward movements of the handle complete the sifting operation. The cover should not be removed for a few seconds to allow the dust to settle. The sifter shown is of handy dimensions, but a larger or smaller size can easily be made from the instructions. The selection of wood is of no account, as almost any kind $\frac{3}{4}$ in. thick will be suitable ; even the wood from an old packing box could be used.

The outer box is nailed together to the dimensions given in Figs. 79 and 80, the ends fitting within the sides, and the bottom fitting over the sides and ends. The runners (*see* Figs. 79 and 80) on which the sifter works are 1 in. deep by $\frac{3}{4}$ in. thick, screwed to the sides of the box in the position shown in Fig. 81. The cover (Fig. 82) is cut slightly larger than the box, say a full $\frac{1}{8}$ in. in both length and breadth, while the overhanging edges are $2\frac{1}{2}$ in. deep by $\frac{1}{2}$ in. thick, mitred at the corners and nailed in position.

The sifter is made to the dimensions given in Fig. 83. The ends fit within the sides, and the sides and ends are nailed together. For the bottom of the sifter a piece of meshed wire having about $\frac{1}{2}$-in. meshes will be required. It should be $\frac{3}{4}$ in. larger all round than the opening in the sifter. The edges are turned over, and the wire is fixed to the sifter with wood fillets nailed in position, as shown in Fig. 84. The sifter should work freely in the box, and it is moved by an iron handle

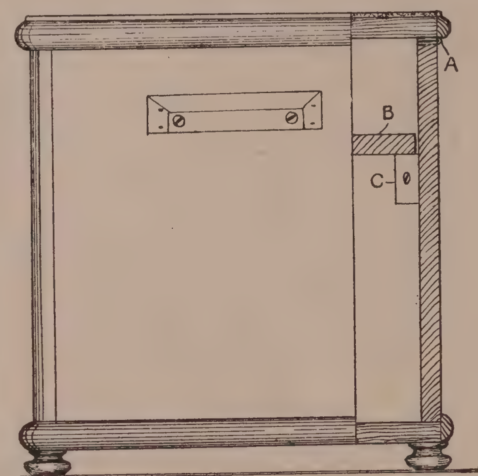


Fig. 73.—Part Elevation and Section of Boot-cleaning Pedestal

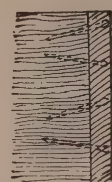


Fig. 72.—Method of "Skew-nailing" Box Sides

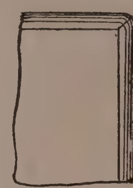


Fig. 74.—Plan of a Top Corner


Fig. 76 — Under-view of Handle

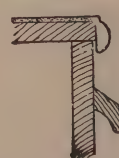


Fig. 75.—Section through Handle Part

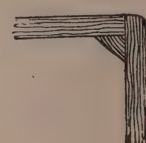


Fig. 77.—Section of Corners of Box Sides

similar to that shown by Fig. 85. This handle should be of $\frac{3}{8}$-in. round iron, having a foot at one end provided with two screw holes for fixing to the sifter, and a bow at the other end. A notch must be cut in one end of the box to allow the handle to work, and also in the cover.

An iron handle could be fitted to the cover, as shown in Fig. 82, and two handles (Fig. 86) could be fitted to the sides of the box to enable it to be moved more easily.

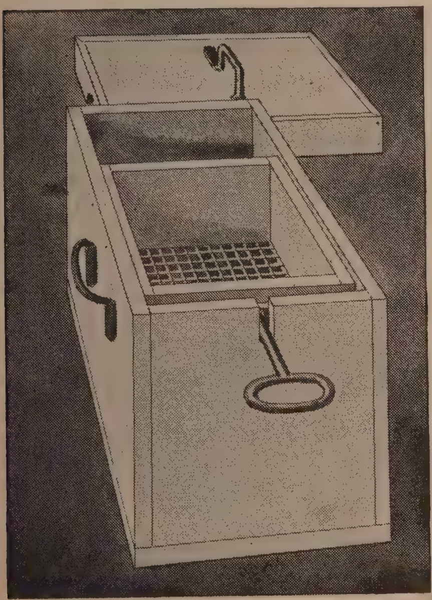


Fig. 78.—Dustless Cinder-sifter

A couple of coats of paint will make the sifter more durable.

FIRELESS COOKER

A fireless cooker or hay-box is shown complete by Fig. 87. It consists of a wood box which is built up with four sides and a bottom, while a cover is hinged to the top edge of one side. The cooker must be fitted with a suitable metal stew-pan, and this is packed in hay, as shown in Fig. 88, while a hay-stuffed cushion is made to fit above the stew-pan.

The cooker as shown in the illustrations is made up with a front and back A and B, which are framed up as shown in Fig. 90. The framework in each case consists of four rails which are 1 ft. long by 2 in. wide by $\frac{3}{4}$ in. thick, and are framed together with half-lapped joints similar to that shown by Fig. 91. The half-lapped joints will not be very difficult to cut. They should be marked off with a square and marking gauge, and cut with a tenon saw; while fixing them together they should be secured with glue and a couple of nails or screws. The front and back frames are lined on the inside with $\frac{1}{4}$-in. boards, which are nailed to the framework. For this purpose there is nothing better than ply-wood.

The front and back must now be connected with two sides C (Fig. 89), each 1 ft. 2 in. long by 1 ft. deep by $\frac{1}{2}$ in. thick of ply-wood, and they are nailed or screwed to the side rails of the front and back framework. The bottom D may also be of ply-wood, and it is 1 ft. 2 in. long by 1 ft. 1 in. wide by $\frac{1}{2}$ in. thick, nailed or screwed to the bottom edges of the front, back, and sides. Two handles E are arranged at the front and back as shown in the illustrations. These handles should be 1 ft. 1 in. long by 1 in. deep by $\frac{1}{2}$ in. thick, and they are simply nailed or screwed in position. The cover F is framed together, as shown in Fig. 92, and is covered on the inside with a $\frac{1}{4}$-in. panel in a similar manner to the front and back. The side rails of the framework are 1 ft. 2 in. long by 2 in. wide by $\frac{3}{4}$ in. thick, and the top and bottom rails are 1 ft. 1 in. long by 2 in. wide by $\frac{3}{4}$ in. thick. The rails are half-lapped and screwed or nailed together, as shown by Fig. 91, while the panel is simply nailed or screwed to the framework. The cover is hinged to the back B with a pair of 2-in. butt hinges, and a catch similar to that shown by Fig. 94 is arranged at the front to secure the cover.

The hay-stuffed cushion which is fitted to the upper portion of the interior of the cooker should be about 4 in. deep, and may be made up as shown by Fig. 93. For the top of the cushion cut a piece of wood 1 ft. square by $\frac{1}{2}$ in. thick, so that it will fit between the sides of the cooker. The hay stuffing is held in place with a linen

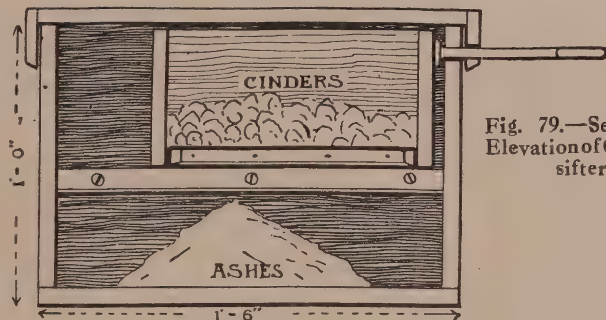


Fig. 79.—Sectional Elevation of Cinder-sifter

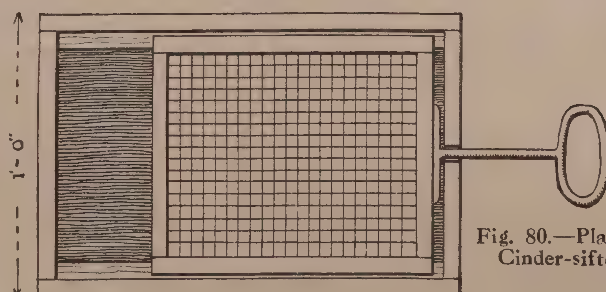


Fig. 80.—Plan of Cinder-sifter

Fig. 82.

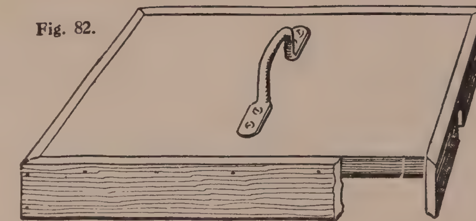
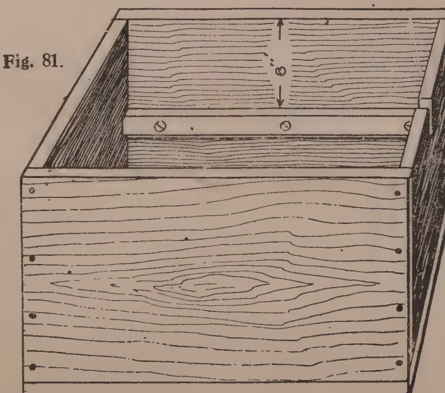


Fig. 81.



Figs. 81 and 82.—Outer Box and Cover of Cinder-sifter

Fig. 84.—Method of Fixing Wire Bottom

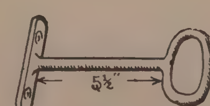


Fig. 85.—Handle for Sifter

Fig. 86.—Handle for Box

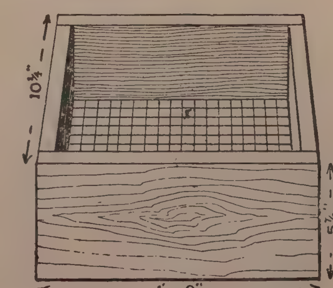


Fig. 83.—Sifter

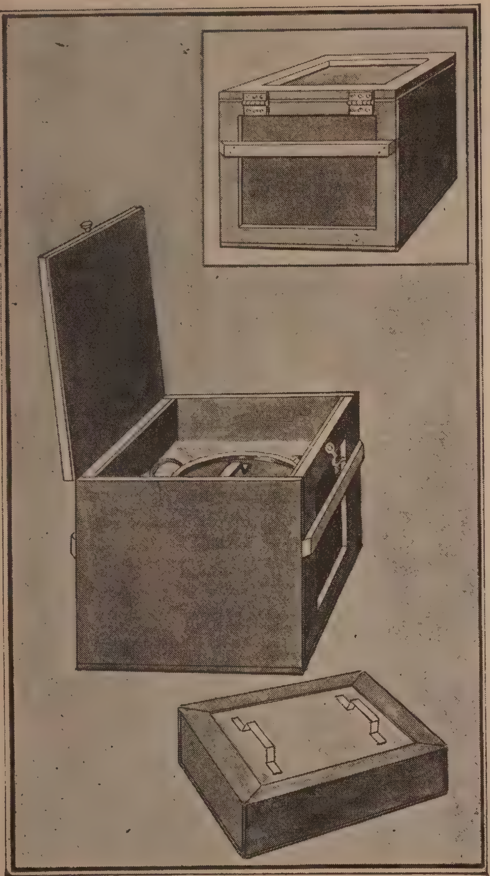


Fig. 87.—Hay-box Cooker. Inset—Back View of Cooker

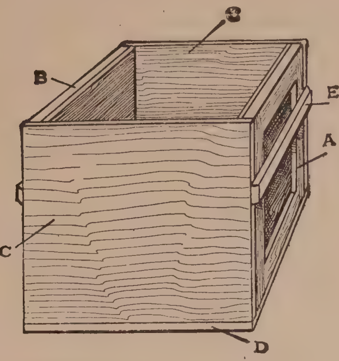


Fig. 89.—Body of Cooker

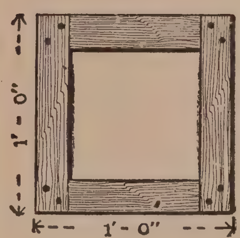


Fig. 90.—Front and Back Frames

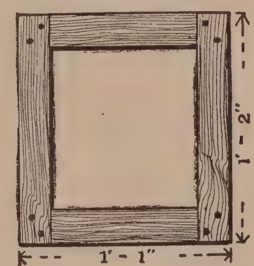


Fig. 92.—Cover Framework

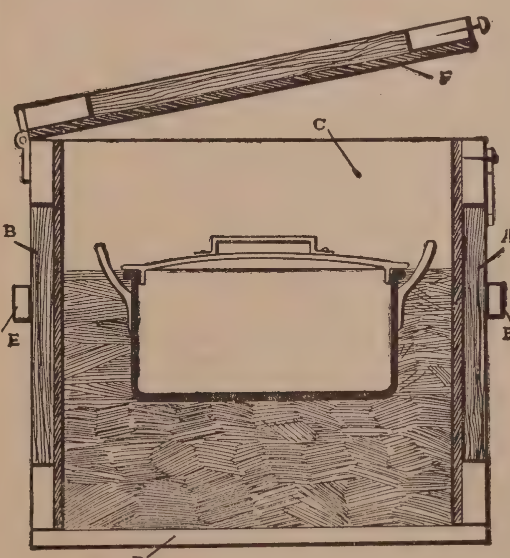


Fig. 88.—Section through Cooker

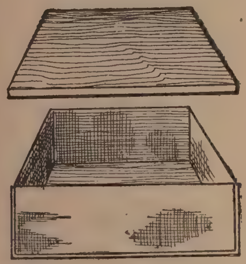


Fig. 93.—Details of Cushion

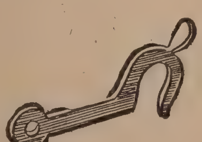


Fig. 94.—Catch for Cover

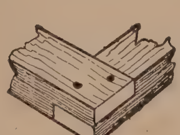


Fig. 91.—Framework Joint

covering, which is made up in the form shown in Fig. 93, and is nailed to the upper face of the board which forms the top of the cushion. Two tape handles could be arranged on this board, as shown in Fig. 87. The stew-pan which should be used in the

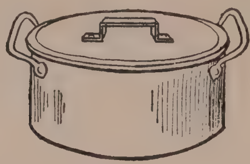


Fig. 95.—Stew-pan for Cooker

cooker should be similar to that shown by Fig. 95. It should be of enamel-ware or, better still, aluminium, and should be 2-qt. size. The stew-pan is arranged in the cooker, as shown in Fig. 88, and is packed in hay, which should be stuffed fairly tight round the pan. The pan is placed so that when the cushion is fitted over the pan, and the cover is closed, the cushion will fit tightly on the pan.

The method of using the cooker is no doubt well known. The stew-pan containing the food to be cooked is simply brought to the boil on the gas or fire, and is then placed in the hay-box cooker. The time required to cook in this way will, of course, vary with the nature of the food being treated; but the great saving in fuel will be very evident to everyone. The cooker, when complete, could be stained and varnished.

WOODEN BATH

At first sight, the advantage of using wood as a material for a bath may appear somewhat doubtful; but in some cases there certainly are advantages, though there is no economy as regards first cost. Wood is lighter as regards weight than iron, and a bath of wood can be removed or even stood on end out of the way when not in use. It is stronger and more durable than zinc, and has the same advantage over this as over iron, while with both zinc and iron there is the question of paint or enamel; but with the wood neither need be used.

The length and width here given will be found sufficient for all purposes; but these dimensions may be reduced to a certain extent to suit. The depth may be anything from 12 in. to 15 in., the latter being preferable, as with this depth the water is not so liable to splash over.

Timber of the best must be used; no knots or shakes must be allowed, and the sides, ends and bottom must each consist of one piece only.

The construction is simple, but good work must be put in or the joints will not be water-tight. The sides of the bath project 1 in. beyond the ends, and are trenched to take the latter, the trenches being made the full width to take the ends. The latter should each be marked into its place and numbered, thus ensuring a perfect fit, which cannot be certain if done in any other way. The subject of determining and setting out bevels is adequately treated in a later chapter.

The trenches need not be more than a $\frac{1}{4}$ in. deep; but they must be equal throughout, and in cutting them the marks must be left on the wood, so that the ends will drive in tightly. When the trenches are finished, the four parts can be fitted together, and the whole planed off level at what will be the bottom of the bath, after which the grooves can be made for the tongues which fit into the bath bottom (Fig. 101) and the sides (and ends).

As may be seen in the sections (Figs. 97 and 99), the grooves must not be made parallel with the sides of the boards, but at right angles to the edges after these have been planed off as previously instructed, otherwise the tongues could not fit in tightly. Fig. 98 shows how the tongues should fit when the bath is together, and Fig. 100 shows one of the sides with the trenches made and the grooves in the edge ready to receive the tongue.

All the grooves made, the sides and ends may be put together permanently, fixing them with brass screws inserted not more than 3 in. between.

When fitting the tongues into the groove fit these in the sides first, then trench the side tongues, as in Fig. 98, so that the

end tongues will fit into them tightly as shown.

The trenches in the bottom should be set out by measurement, and must be made as true as possible, so that the bottom will fit on the tongues without any need for easement, but just friction tight. The bottom will be fixed on with brass screws in the same way as the sides were fixed to the ends, and if the trenching has been done truly, the joints should come up closely without any trouble, and without need for any undue force.

Supplementary pieces to form handles should be screwed to the ends of the bath, level with the top edges, as shown in Figs. 96, 99, and 102. The end boards are cut off level with the handles as shown in Fig. 96.

The finished bath could be left as it is, and the bottom would rest on the floor, but the better way is to provide it with two feet shaped as Fig. 103, and screwed on underneath from the outside.

Nothing has been said as regards putting anything in the joints to make them water-tight, the whole of the joints being simply wood to wood, and depending on the close fitting for their water-tight qualities. The writer considers that this is all that is required, and has no hesitation in stating that if done properly the bath will come up to expectations. At the same time, if any readers feel that they would prefer to use some safeguard in the joints, the following are suitable methods that may be used ; but the plain joints have stood the test satisfactorily in every way. One method of making joints water-tight is to paint them before putting together with thick white-lead paint ; if this is done the paint must be spread very evenly and smoothly, otherwise the remedy will be far from satisfactory, and instead of preventing the paint will cause leakage. Another method is to batter the edges of the boards before making the joints hammering a groove as it were along them

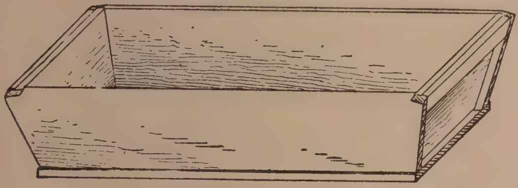


Fig. 96.—Wooden Bath

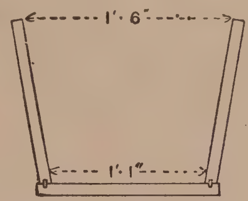


Fig. 97.—Cross Section of Bath

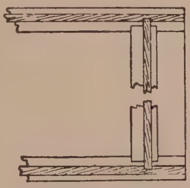


Fig. 98.—Method of Tongueing Ends and Sides to Bottom

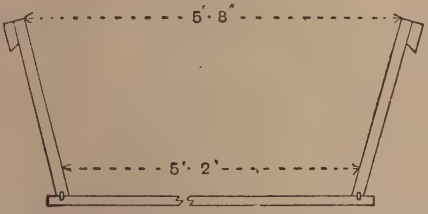


Fig 99.—Longitudinal Section of Bath

Fig. 100.—Side of Bath

Fig. 102. —Handle

Fig. 101.—Grooved Bottom of Bath

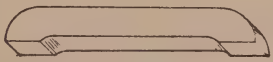


Fig. 103.—Bath Foot

afterwards planing the wood away until the surface is level again. The theory of this method is that the battering compresses the wood, which afterwards returns to its original position, thus tightening up the joint, especially under the influence of water. This sounds very probable in theory, but it does not always work out successfully in practice.

Yet another method of ensuring the joints against leakage is to batter along the edges as mentioned, and then to lay a dried rush (such as are used for chair bottoms) along the groove just formed. The idea is that not only will the wood swell out to its original size, but the rush will expand when it becomes wet, and effectively stop any leakage.

One thing which may be mentioned as being certain, no matter if the bath is made water-tight by means of good joints or by faking, if it is allowed to stand empty for any length of time it will leak. The remedy is to always keep a little water in the bath; or if it is necessary that this should be stowed away on end, then it should be damped occasionally to prevent shrinkage.

It is not advisable to fix a waste pipe for emptying purposes; this can always be done by the use of an indiarubber tube, used as a siphon.

Domestic Racks

STANDING PLATE-RACK

For the plate-rack illustrated by Figs. 1 to 3 good red deal should be used. The dimensions given are for one of a useful size, but these can be varied to meet requirements. For the rails and stiles of the framework, wood $1\frac{1}{4}$ in. thick and $1\frac{1}{4}$ in. or $1\frac{1}{2}$ in. wide will be suitable, except for the two top rails at the ends, which should be twice the breadth of the other rails, so as to allow the tenons to pass over each other, as shown in Fig. 4. The lengths of the various parts and the number of pieces required can be obtained from the illustrations.

First saw off the pieces about $\frac{1}{2}$ in. longer than the finished lengths, and plane the face side and face edges square. Then gauge them to thickness and breadth, and plane. Next set out and make the mortise-and-tenon joints, as

Fig. 1.—Perspective View of Plate-rack

shown in Fig. 4. Then set out the centres of the holes for the bars. The distance apart of the centres for the plate portion should be about 2 in., and for the dish part about 3 in. The holes can next be bored right through or partially, as preferred; the two middle rails should be bored right through. Care must be taken to ensure that these holes are bored as true as possible with a twist bit.

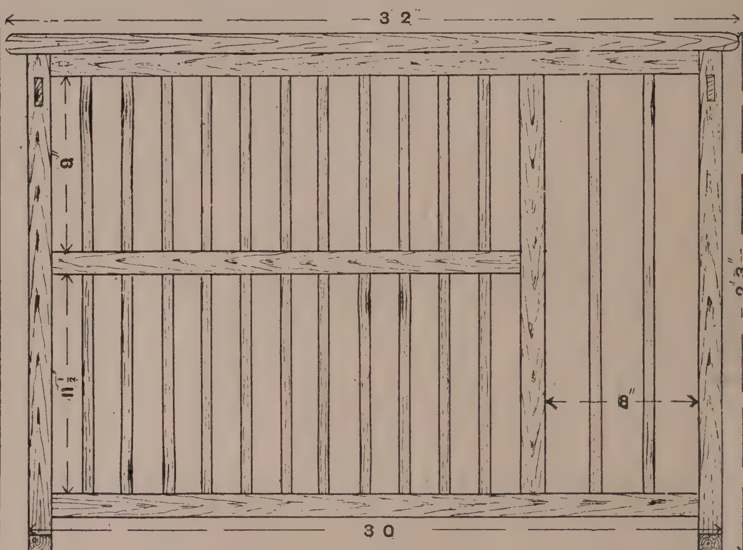


Fig. 2

Fig. 3

Figs. 2 and 3.—Front and End Elevations of Plate-rack.

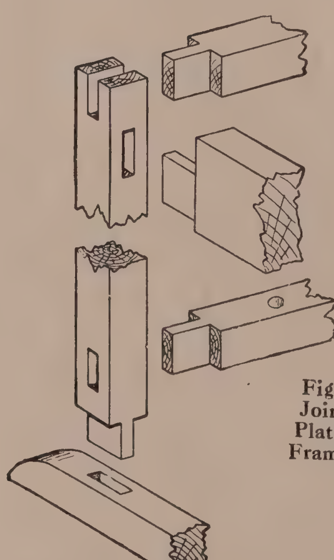


Fig. 4.—Joints of Plate-rack Framework

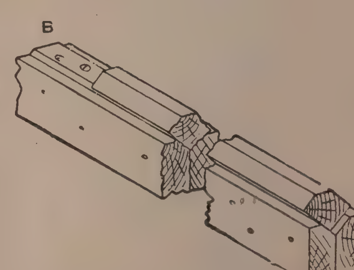


Fig. 5.—Apparatus for Use in Rounding Bars

The bars should be about $\frac{3}{16}$ in. in

diameter, and can be prepared by hand as follows: Cut strips of wood about $\frac{3}{4}$ in. square, and of the full length required, and plane up to $\frac{5}{8}$ in. square. Then plane off each corner so as to form an octagon in section, and next plane the resultant corners so as to form sixteen sides. The strips can then be made almost round with a hollow or bead plane. The bars can be finished with glass-paper. A simple apparatus for holding the bars whilst planing is shown by Fig. 5. It is made by chamfering one edge of two pieces of wood and nailing them together as shown. A piece of wood should be nailed at one end to form a stop as shown at B.

The plate-rack should now be fitted together and the tenons wedged into the mortises or fastened with hardwood pins. The joints should be painted with a little white-lead and red-lead mixed with a little oil before fastening together; this preserves the joints and is better than glue. Any projecting parts of the joints should be smoothed off and the two parts connected to the feet pieces and top rails. The top is made of a 1-in. board, with the edges rounded as shown in Fig. 1; it should be secured to the top rails by means of a few nails or screws.

HANGING PLATE-RACK

The plate-rack or drainer shown by Fig. 6 is made almost entirely of $\frac{1}{2}$-in. wood, and holds three dozen plates in three sizes. A special place has not been made for dishes, but the top is made full, so that if desired they can rest on it, leaning against the wall, and prevented from slipping by means of a small bead or fillet fixed along the front.

The two side pieces (Fig. 8) should be prepared first, the curved bottoms being cut out with a bow-saw, and finished with a spokeshave. To form the bars or uprights A (Figs. 7 and 10) which keep the plates in their places, rip two boards, 2 ft. $8\frac{1}{2}$ in. by 11 in. by $\frac{1}{2}$ in., each into eleven equal strips, which must then be planed down to $\frac{3}{4}$ in. wide. The four thicker horizontal pieces are prepared about 1 in. thick and exactly 2 ft. 1 in. long; three of them are $1\frac{1}{4}$ in. wide, as at B in Fig. 9, and the fourth is $2\frac{1}{4}$ in., as at

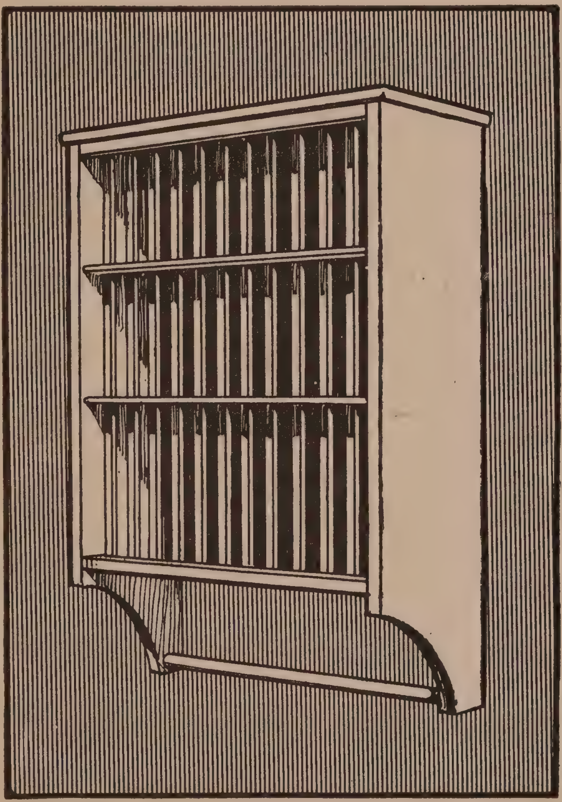


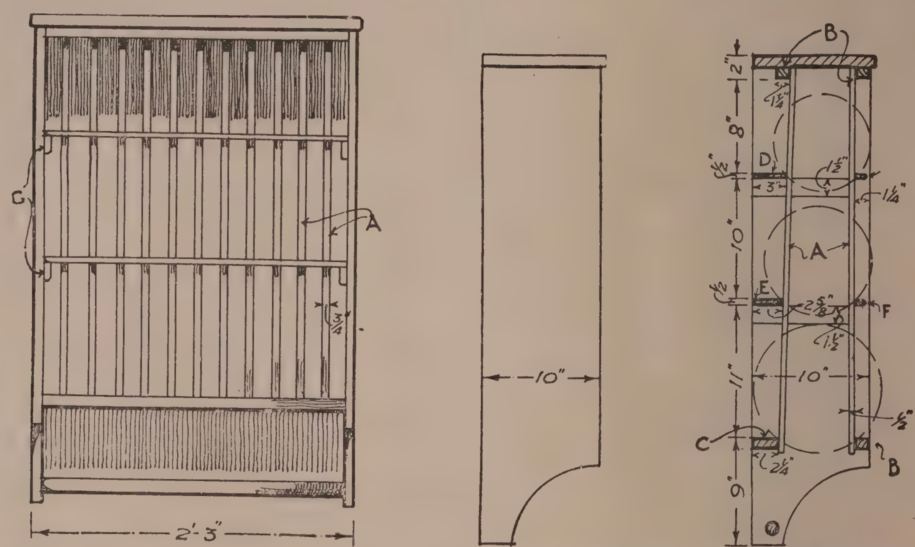
Fig. 6.—Hanging Plate-rack

C in the same figure. The two bottom pieces should each have the top inside corner slightly bevelled off. Take two of the narrower pieces, and, starting $1\frac{3}{8}$ in. from one end, screw at even distances along them eleven of the $\frac{3}{4}$-in. strips, with their ends flush with the top piece, and lapped over the other slightly. Before screwing on the eleven other strips slightly bevel one edge of the horizontal pieces, and so compensate for the slight rake of the set of upright pieces nearer the wall.

Now get out the thinner horizontal strips, one D 3 in. wide, one E $2\frac{5}{8}$ in., and two F 1 in. wide, all as in Fig. 9. Slightly bevel off the inside top corners, and fasten with brads and screws to the upright pieces. There are now two grids, which can be connected by attaching the four battens, $\frac{3}{4}$ in. thick, which support them in position, two at each end, as at G in which method the screw-heads are hidden, although this is rather awkward to do. A piece of broom-handle will serve for the dishcloth rod shown at the bottom.

IMPROVED PLATE-RACK

A rack of larger dimensions that will contain all the table crockery-ware is



Figs. 7, 8 and 9.—Front and Side Elevations and Vertical Section of Hanging Plate-rack

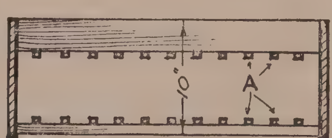


Fig. 10.—Plan of Plate-rack

Fig. 7. Place the double grid on the floor, resting it on one end; lay one side piece carefully in its place on top, set off screw-holes accurately, and from the outside screw the battens in position; also put screws into the ends of the thick horizontal pieces. Turn it over, and, if all is square, screw on the other side in the same manner. It is quite possible to screw the battens on from the inside, by

shown in Fig. 11. It is constructed to receive the usual plates and dishes in the upper part of the rack, and to receive all cups, saucers, basins, and jugs in the lower rack. The complete rack is a full average size, and in most cases will prove sufficiently large enough for family use.

The most suitable material to use is yellow deal; but white deal can be used if free from knots. The outside dimen-

sions are 2 ft. 8 in. high, 2 ft. 10 in. wide, and the space between the front and back frames is 5½ in. It will be seen that the lower rack is much wider than 5½ in., because the space behind the frames is utilised, which gives a width of 8 in. or more. The length of the lower part is 2 ft. 10 in., being the same as the width of the rack. A wide bar is arranged on the back frame, on the part that receives the small plates, so as to hold the very small plates if required. This bar also has small grooves cut in its corner to prevent the smaller plates slipping sidewise. The lower rack is a crate-like arrangement. The fillets are nailed on with ½-in. spaces, which are sufficient to allow the saucers to be placed in vertically. Such articles as cups, basins, and jugs should be racked in a tilted position for better drainage, so the spaces between the fillets enable one to place them in

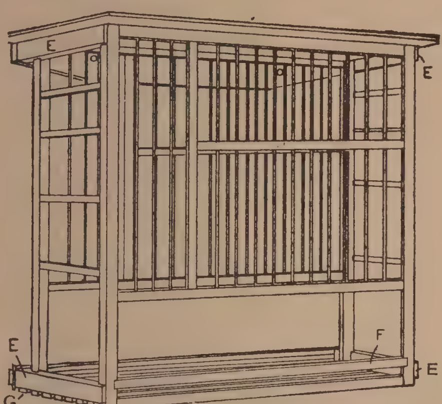


Fig. 11.—Perspective View of Improved Plate-rack

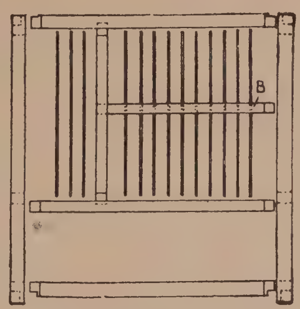


Fig. 15.—Frame Ready for Fixing Together

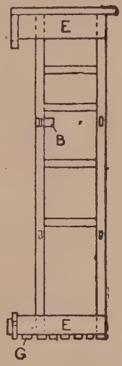


Fig. 16.—End Elevation of Rack

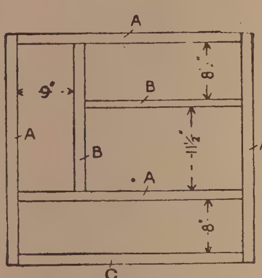


Fig. 12.—Front Frame

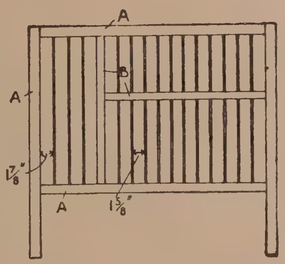


Fig. 13.—Back Frame

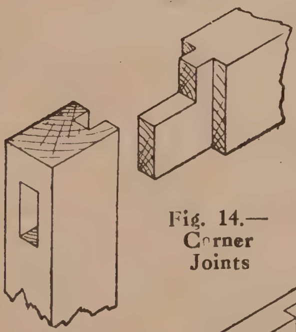


Fig. 14.—Corner Joints

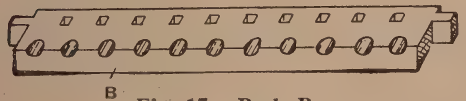


Fig. 17.—Back Bar

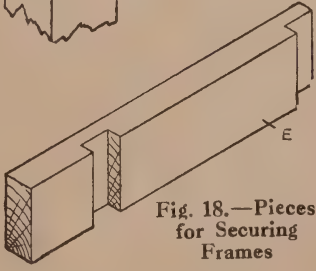


Fig. 18.—Pieces for Securing Frames

at random without danger of breakage through slipping.

Figs. 12 and 13 show the front and back frames respectively. The bars and posts A are finished $1\frac{1}{4}$ in. wide, B is 1 in. wide, and the front bottom bar C is $1\frac{1}{2}$ in. wide. All these bars are made of 1-in. material, so that when the frames are finished they are $\frac{7}{8}$ in. thick. The bar B on the back frame is finished 2 in. wide and 1 in. thick for the smaller plates. It will be noticed there is not a lower bar on the back frame, like C on the front one. All the joints are wedged mortise-and-tenon, with tenons $\frac{3}{8}$ in. thick. The corner joints are haunched, as shown in Fig. 14. Round rods $\frac{1}{2}$ in. in diameter can be obtained for the plate bars; or $\frac{1}{2}$ in. square bars can be made and fixed with a little extra trouble.

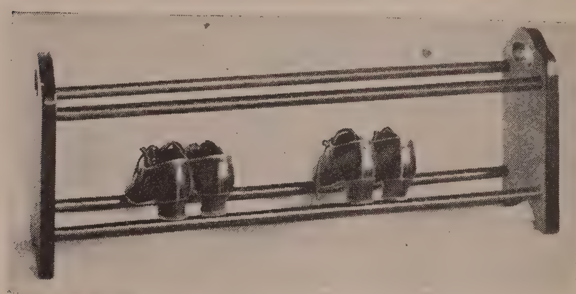


Fig. 19.—Simple Boot and Shoe Rack

When ready for gluing together, the plate bars should first be driven into the horizontal bars B. The middle vertical posts are then glued and wedged on square and the ends of the tenons smoothed off before the top and bottom rails are fixed. Finally the outer posts complete the framing. Fig. 15 shows this method of fixing. The end view of the rack is shown in Fig. 16. The back bar B is shown to project; the notches are cut as in Fig. 17. The four pieces E are grooved to fit over the outside posts and to project 2 in. at the back to give clearance for the plates. These are of $2\frac{1}{4}$-in. by 1-in. material, and grooved $\frac{1}{2}$ in. deep, as in Fig. 18. They are then secured with nails, so as to be flush with the top and bottom of the frames. The back board, with two holes for supporting the rack, is 3 in. by $\frac{3}{4}$ in. and nailed on the back ends of the top pieces. Two fillets for the lower rack, $1\frac{1}{4}$ in. by $\frac{5}{8}$ in., are nailed on to the back ends of the lower pieces, and fillets of the same material on the bottom. The front fillet F (Fig. 11) should be neatly let in flush and bradded. The fillets should be arranged so as not to have any corroding corners. The fillets G (Figs. 11 and 16) are fixed away from the side pieces with this object. Two small pieces $\frac{3}{8}$ in. thick are nailed at the back of the lower rack so that the fillets shall clear the wall.

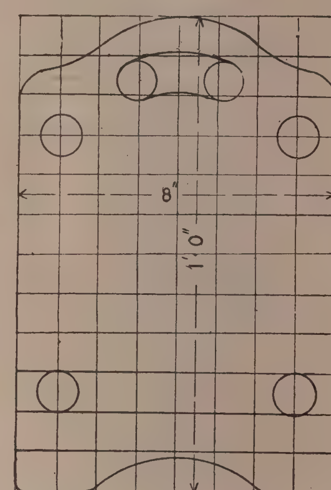


Fig. 20.—Method of Setting-out Rack Ends

The covering board for the top is made of $\frac{1}{2}$-in. material, and overhangs the rack a trifle at the ends and front.

BOOT AND SHOE RACKS

Fig. 19 shows a rack of very simple construction. It is made in oak of 1-in. thickness. For the two end pieces a pattern may be drawn on stiff paper, ruling it into 1 in. squares, as in Fig. 20. It can then be cut out to the shape to mark on to the wood. The hand-holes are made by boring two holes with a 1-in. centre-bit and cutting through with a bow-saw. The rail-holes are $\frac{3}{4}$ in. deep.

The rails may be any length required ; in the present case they are 2 ft. 9 in. They are first cut 1 in. square, and marked on each end with the compasses to 1 in. diameter ; then they are rounded with the hand-planes and smoothed up with glasspaper. In smoothing up the end boards all the square corners are rounded off. The rail ends are tight-fitting in the holes and well glued in.

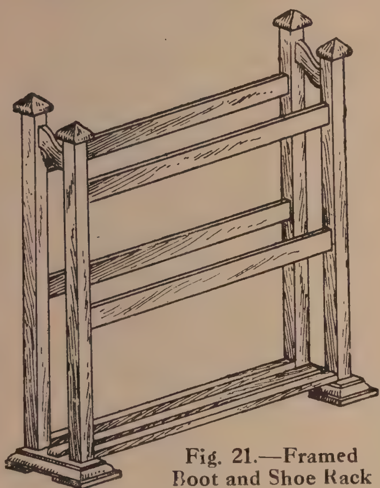


Fig. 21.—Framed Boot and Shoe Rack

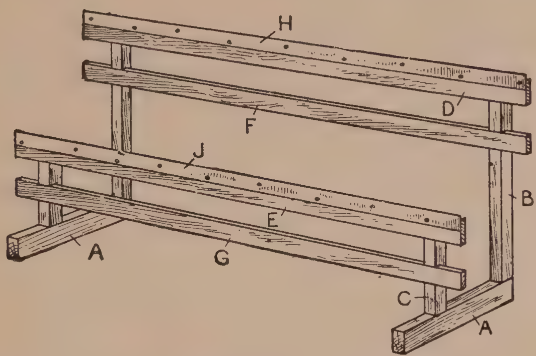
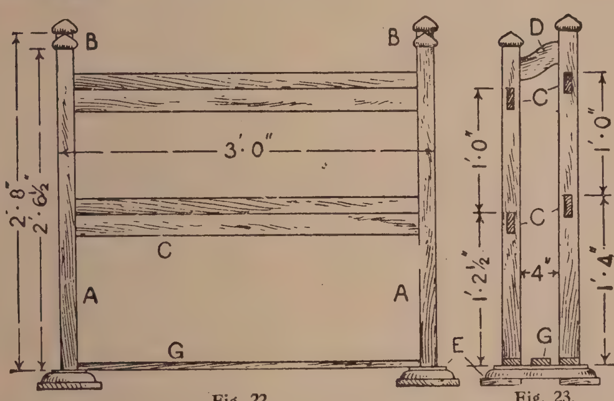


Fig. 27.—Hanging Boot and Shoe Rack



Figs. 22 and 23.—Front Elevation and Section of Framed Rack

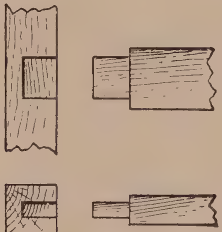


Fig. 25.—Frame Joints

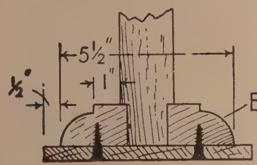


Fig. 26.—Lower End of One Upright of Framed Rack

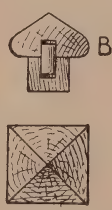


Fig. 24.—Corner Joint

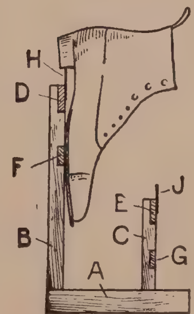


Fig. 28.—End Elevation of Hanging Rack

Care should be taken to see that the rack is square and level. When the glue is set, the oak may be stained with a solution of vandyke brown in soda and water. This raises the grain and makes it rough, so it requires another rub down with No. 1 glasspaper. Then it should be rubbed over with linseed oil and finished with french polish.

The boot and shoe rack shown by Fig. 21 should be made of oak, fumed or stained a golden brown colour, and wax-polished. If made of soft wood, such as pitchpine, it should be varnished. Figs. 22 and 23 are front elevation and section respectively, and if made to the dimensions shown it will be suitable for all ordinary requirements and be found compact and convenient.

The four posts A (Fig. 22) are $1\frac{1}{2}$ in. square, and have on the top a square finial B secured by a dowel, as shown in Fig. 24. The rails C, to finish 2 in. wide by $\frac{3}{4}$ in. thick, are fixed to the posts A, as shown in Fig. 25. The curved end rails D (Fig. 23) are also 2 in. wide by $\frac{3}{4}$ in. thick, and are secured to the posts A with two small dowels in each end ; or they could be secured by a joint similar to that shown in Fig. 25. The lower ends of the posts A are secured to the feet E, as shown in Fig. 26, the end of each being reduced to 1 in. square, and glued and wedged. The feet E $1\frac{1}{4}$ in. thick, and of the dimensions given, are moulded on all four edges, the pieces F being separate, and screwed to the underside as shown. The three bottom rails G are $1\frac{1}{2}$ in. wide by $\frac{5}{8}$ in. thick, the two outside ones being flush on both edges with the posts A, as shown in Fig. 23. The centre rail is 3 in. longer than the outside ones, and finishes level with the outside of the posts A, as shown in Fig. 21 ; the end of this rail should be rounded as shown. They are all secured to the feet E with screws driven from the underside.

Figs. 27 and 28 show a rack of entirely different design to those previously described.

Prepare two pieces of wood 9 in. by 2 in. by 1 in. for the feet A. At one end of each foot fasten an upright B of 1-in. stuff, 1 ft. 4 in. high. Then 5 in. nearer the front of each foot fasten two other uprights C 9 in. long. These four uprights may be screwed or nailed to the feet, or they may be halved on as shown. Connect the uprights of one foot to the uprights of the other foot by pieces D and E of $\frac{1}{2}$-in. stuff, 2 in. wide and 2 ft. 6 in. long. Two inches below, and parallel to D and E, rails F and G must be fastened to the uprights, against which the sides of the boots rest when hanging in position. These rails should measure $\frac{1}{2}$ in. by 1 in. by 2 ft. 6 in. Along the upper part of the face of each top rail screw or tack strips of zinc H and J $1\frac{1}{2}$ in. wide. This zinc must project at least $\frac{1}{4}$ in. above the upper edge of the wood. A piece of old zinc from a roof answers admirably. The success or failure of the rack depends to a large extent on this strip of metal, the edge of which takes a grip of the leather in a manner far superior to any wooden edge.

The rack described will accommodate twelve pairs of boots or shoes.

Pigeon Cote and Rabbit Hutches

SMALL PIGEON COTE

THE photograph, Fig. 1, shows a simple design for an eight-pair pigeon cote, and the following description gives the method of its construction. Fig. 2 is an elevation. Vertical and horizontal sections with underneath plan are given in Figs. 3, 4 and 6 respectively.

The base A (Fig. 5) should be constructed first, of boarding $1\frac{1}{4}$ in. thick, each piece being 2 ft. 8 in. long and tongued and grooved together, as shown by Fig. 11, the whole of the base being worked to finish 2 ft. 8 in. square. In fitting these pieces together it will be advisable to consider how they are likely to warp afterwards, and arrange them in such a manner that the warp of one piece will counterbalance the warp of the other. On looking at the ends of the boarding the "annular rings" will be clearly seen as marked on Fig. 15. To minimise the warping, fit these together with the annular rings showing alternately alike as in Fig. 11. Having fitted the base piece together, mark on the position of groove B (Fig. 5), 1 in. wide, where the sides of the cote fit into the same. The outside line of the groove should finish 4 in. from the edge of the base all round, making a square of 2 ft. The boards may now be taken apart and each grooved separately $\frac{1}{2}$ in. deep, using a chisel, and afterwards fitted together as before and nailed to the ledges C, which are 3 in. wide, 1 in. thick, and 2 ft. 5 in. long (*see* Fig. 12), with chamfered edges as shown on the enlarged section.

The sides of the cote are fitted with tongued-and-grooved boarding set slanting to finish 2 ft. square at the base and 1 ft. 8 in. square at the top. These may be butted together at the angles or rebated, as shown in Fig. 14. The latter joint is preferable to the former, which is liable to gape if the wood shrinks. The pigeon holes are cut out of the middle piece of each side, and should be not less than $3\frac{3}{4}$ in. wide. Fig. 19 shows a side complete, nailed to the battens D, 2 in. by $\frac{3}{4}$ in., and E, $1\frac{1}{2}$ in. by $\frac{1}{2}$ in. The angle jointing of these battens is shown externally by Fig. 20 and internally by Fig. 8. Fig. 18 shows the jointing of the partitions where they intersect. The $\frac{3}{4}$-in floor division is nailed to the battens D, and the ceiling piece to the top of the sides all round, projecting as shown 4 in. beyond the top edge.

The roofing ribs are shown by G and H (Figs. 16 and 17), and can be cut out of one piece $8\frac{1}{2}$ in. by 2 in. by 3 ft. 1 in. Fig.10 shows these ribs fixed diagonally across the ceiling F with the tilting fillets J in position. These fillets should also be cut out of one piece of wood, the best method being as follows: Take a piece of wood $3\frac{1}{2}$ in. by 2 in. and about 4 ft. 3 in. long, and halve it by cutting it along one of its diagonals, as in Fig. 21. This will give an angle of 30°, which is to be the pitch of the roof. Each

piece should now be cut in half, and the ends cut across to mitre with the ribs. The fillets are now ready to be fixed to the ceiling F as indicated on the roof plan and the enlarged section, which show their edges finishing about $\frac{1}{2}$ in. from the edge and parallel with the sides of the ceiling.

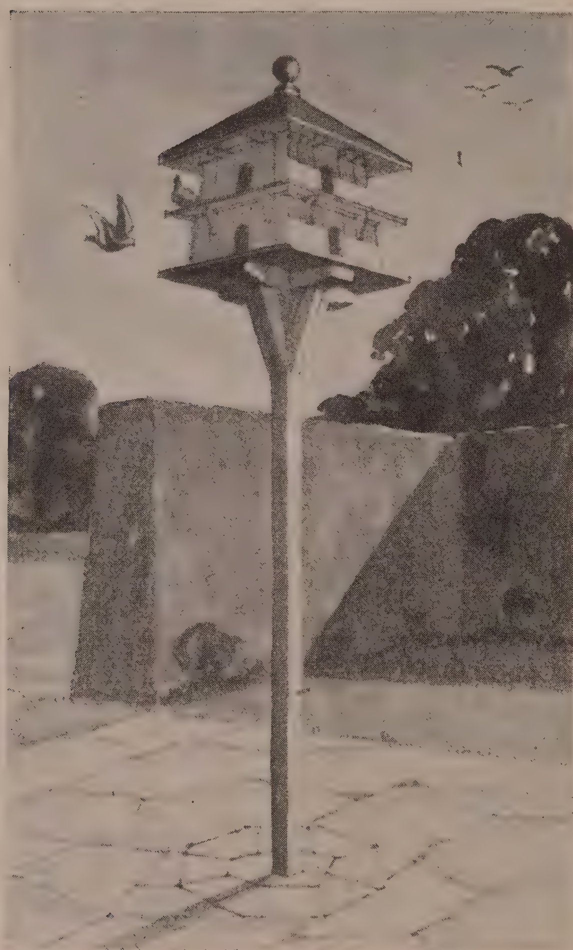


Fig. 1.—General View of Pigeon Cote

Having nailed up the ribs and tilting fillets to the ceiling F, plane off the top edges of the ribs and the ceiling F to the angle necessary to form a mitre joint with the splayed edges of the roof boarding.

The roof will now look as in Fig. 10, and is ready for the boarding, which may be cut out of a piece 14 ft. 3 in. long by 9 in. wide by $\frac{3}{4}$ in. thick into the finished shapes (*see* Fig. 13). The pieces M form the top of the roof and pieces K the lower part (*see* Fig. 7). In fitting these to the ribs G and H care should be taken to splay them so that they will mitre correctly with the splayed ribs as before mentioned, before nailing to the ribs, fillet, etc. The finial N is turned out of a 4-in. by 4-in. piece, the base being square and cut down to 3 in. by 3 in., and fixed on the apex of the roof over the felt. To do this it will be necessary to cut off the apex of the roof as shown on the enlarged section. Three stages of the construction of the roof are shown in Fig. 5.

The roofing felt is cut in four triangles, and is tacked on with the lower edges overlapping the sides of the cote to form a drip for the rainwater. The angles are covered with a strip 3 in. wide tacked down as shown on the roof plan.

Fig. 9 shows the pigeon rest O in perspective. This is 4 in. wide. It runs all round the cote, mitreing at the angles as shown, and is supported on eight brackets P and fillets Q. The ornamental brackets R (Fig. 21) are screwed on immediately over and central with the brackets P, and should be cut out of a 3-in. by $1\frac{1}{4}$-in. by 3-in. piece. This completes the construction of the pigeon cote, leaving to be considered the post and the method of fixing the cote to it.

The post is 4 in. by 4 in. on plan and about 10 ft. long. The corbel pieces S are each 3 ft. long and halved where they cross in the centre, and well secured to the base A and the top of the post. As will be seen on the enlarged section, grooves are cut at each end of the corbel piece where the ledges C fit into same when the core is in position. The struts T are 3 in. by 2 in.,

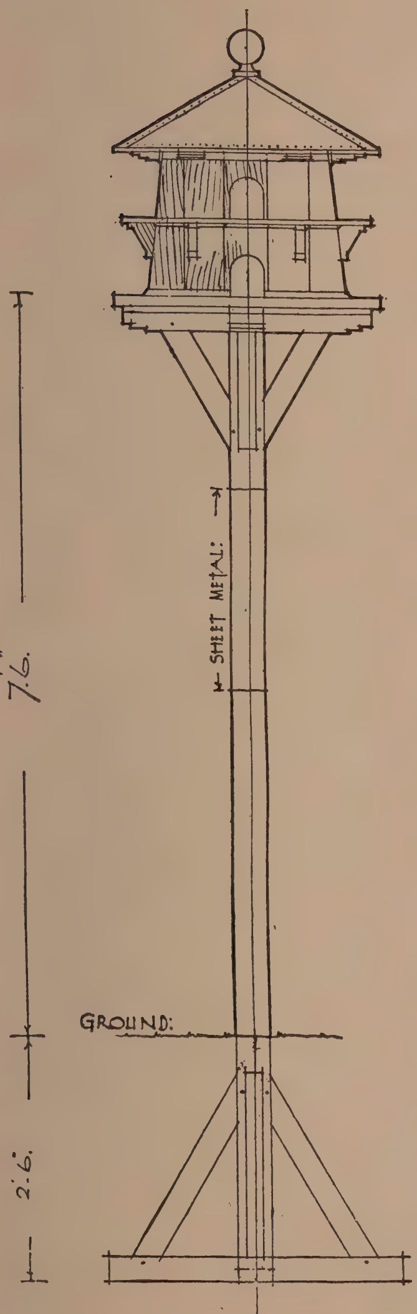


Fig. 2.—Elevation of Cote

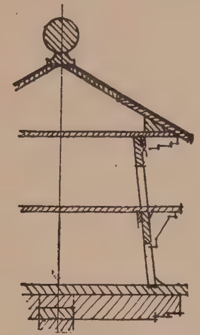


Fig. 3.—Vertical Section

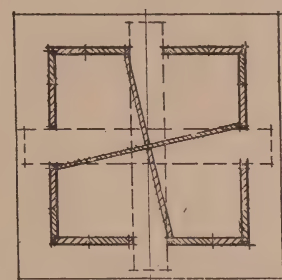


Fig. 4.—Horizontal Section

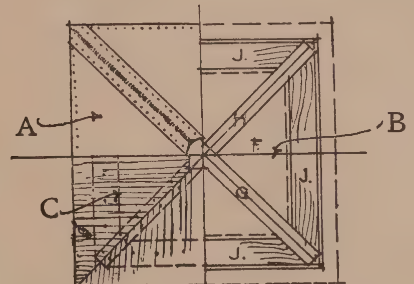


Fig. 5.—A, Finished Roof; B, Roof without Boarding; C, Roof Boarding

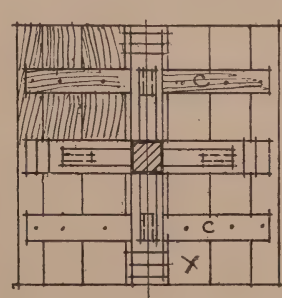


Fig. 6.—Underneath Plan of Base A

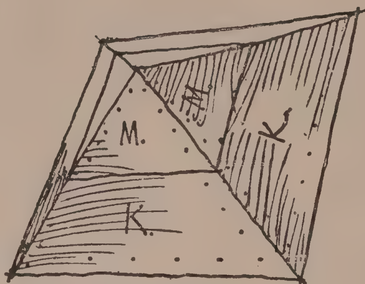


Fig. 7.—Roof Boarding Fixed

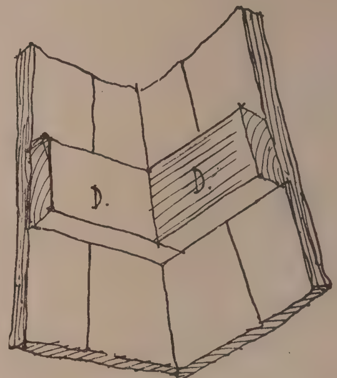


Fig. 8.—Internal Angle of Side

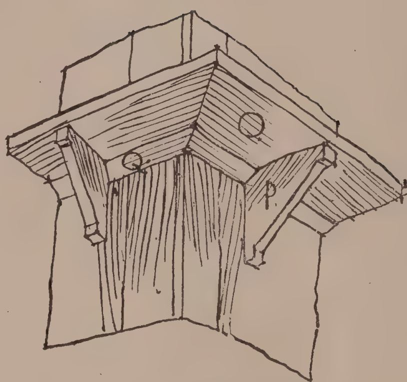


Fig. 9.—Pigeon Rest

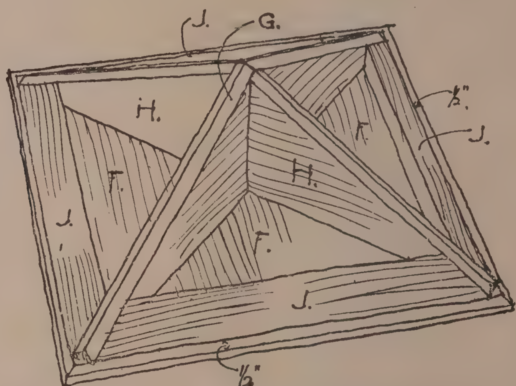


Fig. 10.—Roof and Framing ready for Boarding

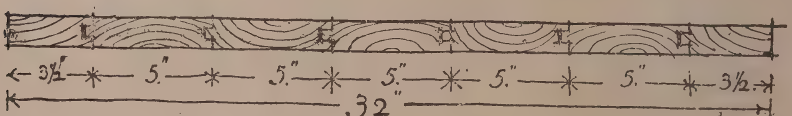


Fig. 11.—Section through Boarding of Base

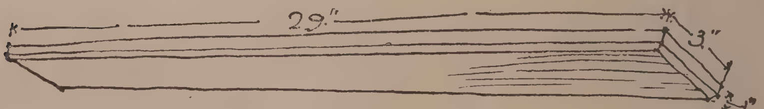


Fig. 12.—Ledges, C

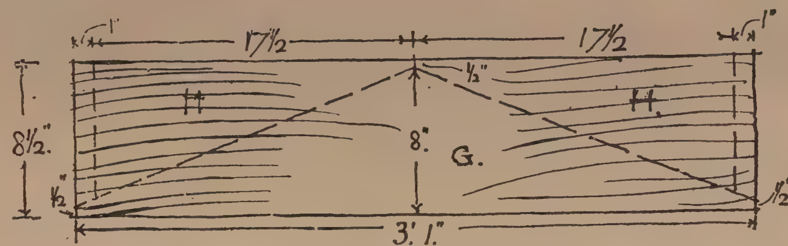


Fig. 16.—Cutting Roofing Ribs from One Piece

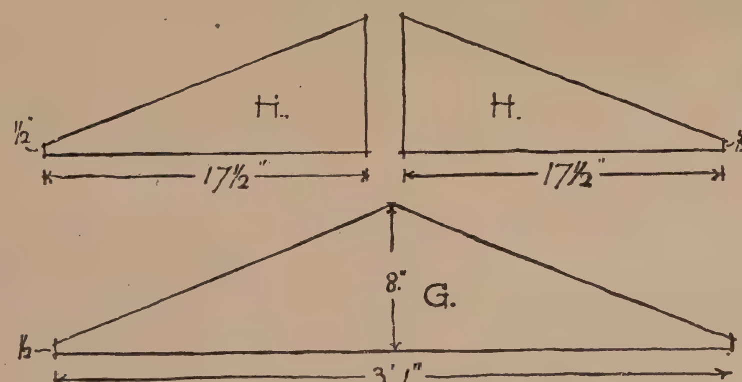


Fig. 17.—Ribs Cut Ready for Fixing

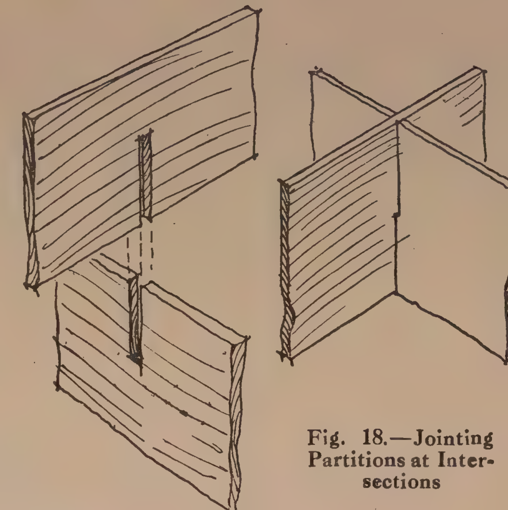


Fig. 18.—Jointing Partitions at Intersections

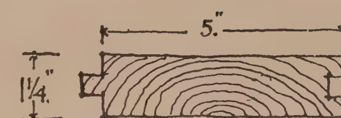


Fig. 15.—Section through Baseboard

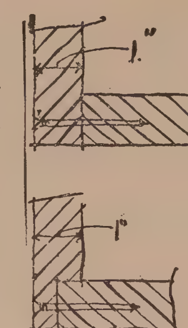


Fig. 14.—Butt and Rebated Joint for Sides

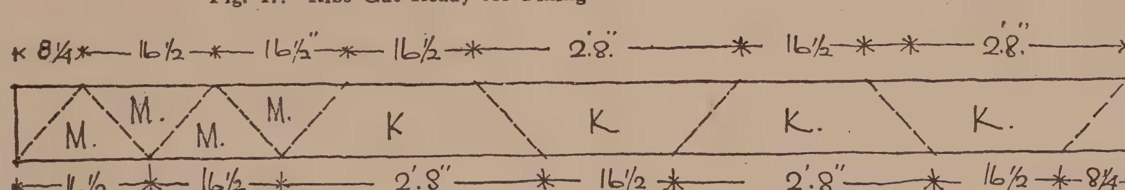


Fig. 13.—Setting Out for Cutting Roof Boarding

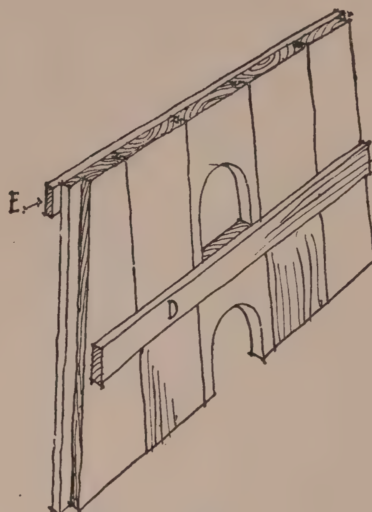


Fig. 19.—Side of Cote

Fig. 20.—External Angle of Sides

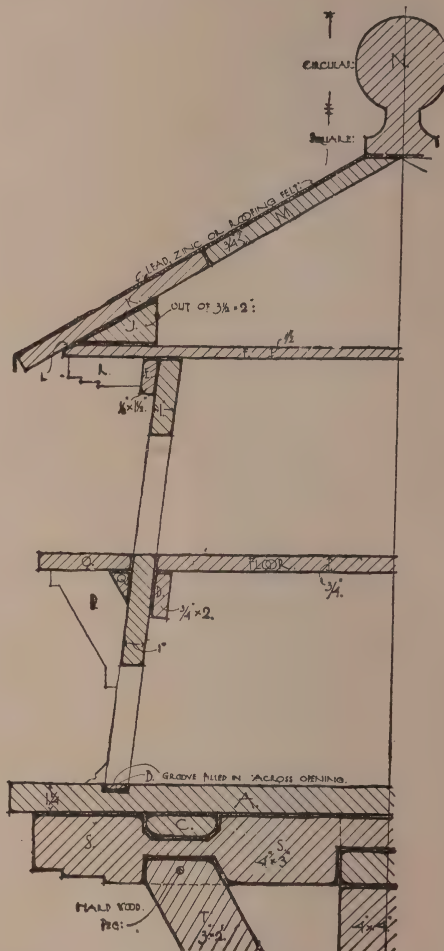


Fig. 21.—Vertical Section through Cote

Fig. 22.—Scale for Figs. 2 to 6

and fixed into the corbels s and the post with tenons and oak pegs. The bottom of the post has struts and sill piece as shown, and is taken 2 ft. 6 in. into the ground.

It is not unusual for a cat to climb the post. A good way of avoiding such an intrusion is to nail a strip of sheet metal about 2 ft. long round the post at a distance of 3 ft. 6 in. from the ground. It is suggested that the whole, with the exception of the roof and sides of the cote, should be

painted three coats of dark green colour, the roof being left the colour of the material with which it is covered, and the sides painted white. The part of the post, etc., below the ground level should be coated with tar, creosote, or some other preservative to prevent the wood rotting. When filling up the hole after inserting the end of the post, ram the earth well down after every few spadefuls.

EASILY-MADE RABBIT HUTCH

A rabbit hutch of very simple construction is shown by Fig. 23. Put together a box of suitable size; or get a common packing-case and remove the lid and one of the long sides. Use this side to heighten the back A, as at B (Fig. 24), fastening it by wood strips D. Cut out two pieces C, and fasten them by strips E to form the body of the hutch. Cut out a piece to the shape of the sides C (one piece if possible) so as to form partition F. Measure one-third the length of the hutch from the end, and before inserting the partition, cut out a square of 4 in. or 5 in. from the corner to form the opening shown at G. Insert the partition, and place the lid on the three sloping pieces. Fasten down to form the sloping roof, and round the front of the day compartment nail strips as at H in Fig. 25, butted or halved at the angles. This framework with wires should form half of the front, leaving a narrow door.

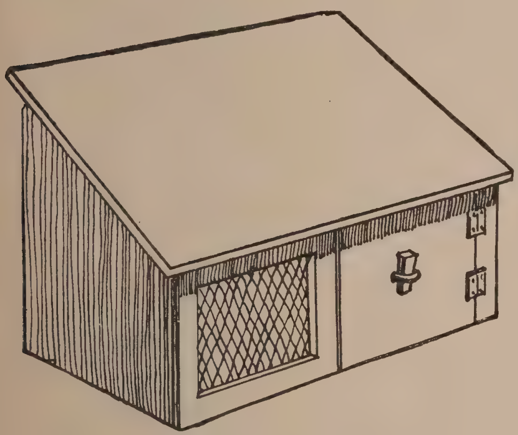


Fig. 23.—Simple Rabbit Hutch

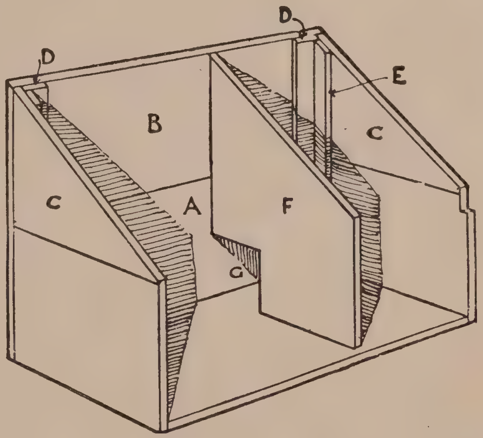


Fig. 24.—Body of Hutch

The outer door J covers both the opening K (Fig. 26) and the sleeping room, as shown on the plan in Fig. 27. On the partition fasten a stout strip, indicated by dotted lines L (Fig. 25), and hammer a staple to this. Opposite this cut a slit in the door to allow the staple to slip through, a bolt or padlock being used to secure it; or a simple wedge, as in Fig. 23, might be used. The dark or sleeping compartment should be hidden by an inner door hung as shown at M in Figs. 26, 27 and 28, to secure a quiet place while breeding. The roof should be covered with tarred felt, and it will be advisable to project it a little all round, as shown in Fig. 23.

FRAMED RABBIT HUTCH

A comfortable hutch that would be suitable for breeding rabbits is shown by the half-tone reproduction, Fig. 29. It has two compartments, with doors panelled with wire netting, and a slanting roof so that the rain can run off freely behind. A loft is made of the upper part, opening at the front, for holding a supply of hay or straw for bedding. The hutch is also provided with outer doors or shut-

ters to close at night or in severe weather, and at ordinary times to fold back to the sides, as indicated by the dotted cross in Fig. 36. Fig. 34 is a view of the front with the loft door and shutters closed. The timber required is as follows: 54 ft. of 2-in. square scantling; 20 ft. of 2-in. by 1-in. scantling; 20 ft. of ½-in. tongue-and-groove board (sometimes termed matchboard) 6 in. wide. It is as well to keep the timber for a week or two in a dry place before using, to allow it to shrink.

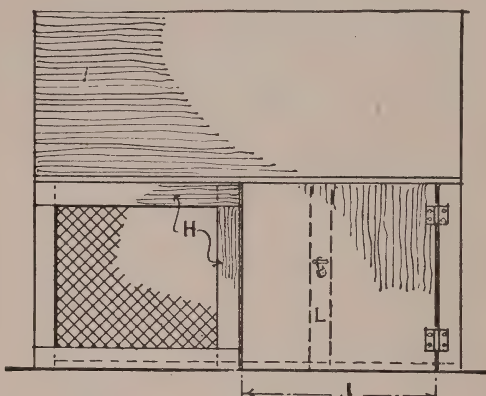


Fig. 25.—Front Elevation of Hutch

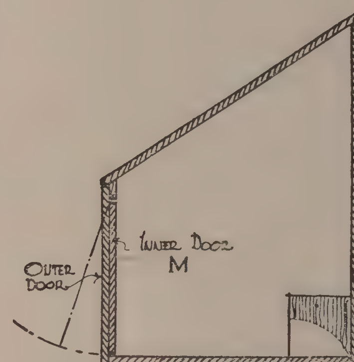


Fig. 28.—Cross Section

Scale, ¾ in. = 1 ft.

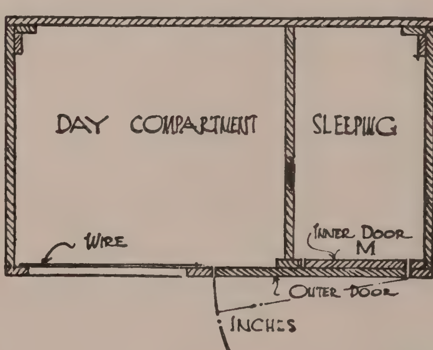


Fig. 27.—Plan

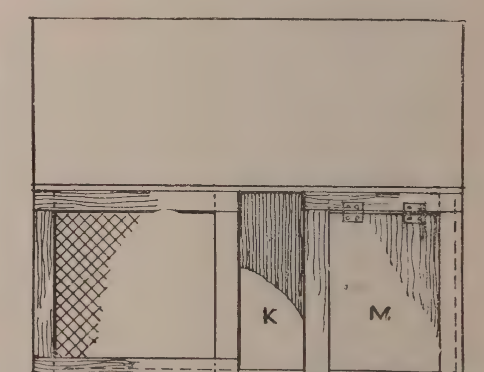


Fig. 26.—Front Elevation with Outer Door Removed

The framework (*see* Fig. 33) is first built up, with the 2-in. square scantling, to the dimensions given in Figs. 30 to 32. The two front uprights, 4 ft. long, and the two back uprights, 3 ft. 3 in., are cut first; then five rails 4 ft. long, and four 1 ft. 7½ in. The method of jointing is shown by Fig. 37; A is the upper portion of the left-hand front upright, B the end of the second long rail, C the end of the short rail, D the top long rail, and E the top short rail. The front uprights are cut on the front

side, 1 ft. 4 in. from the lower end, ½ in. deep, to the width of the rails, the waste being chiselled out; and the rail is then cut to fit. The other rail is fitted, 1 ft. 7 in. above it, in the same way. Two more are joined in a similar position to the back uprights. The long rails must not be fixed until the four side rails have been fitted; the ends of these are quite square, and are let into the uprights ½ in. deep as at C, rail. The cross-pieces H and J (Fig. 33) are simply cut to fit tight between the two lower rails, and then secured with long nails. The top ends of the uprights will require to be cut on the slant for the two sloping side rails, which are cut from the 2-in. by 1-in. stuff and nailed on as at A in Fig. 37. When this has been done, the top of the front upwards must be cut out to take the top long rail, as shown at D. A

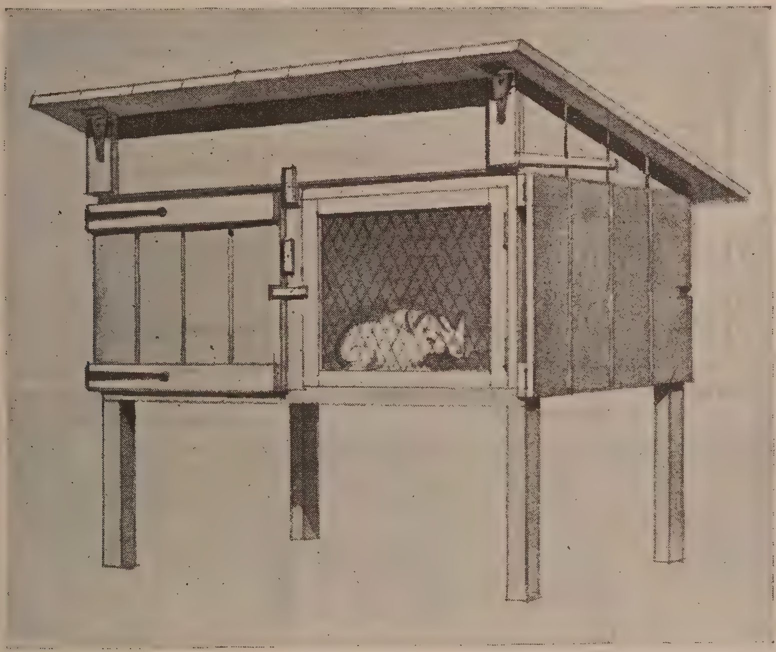


Fig. 29.—General View of Rabbit Hutch

corresponding in level with the long rails. When they are tightly fitted they must be nailed with 3-in. cut nails, two to each joint, first piercing with a suitable sprig bit to avoid splitting. The two ends of the framework may now be stood up 4 ft. apart, with the back uprights to the ground, and the two long front rails nailed in place; then turned over and the back rails fixed in the same way.

The frame may now be placed upright, and the two division pieces cut, 1 ft. 7½ in. long, and fitted midway by letting the ends into the rails, as shown in Fig. 38, where F is the division piece and G the lower back-strip must be nailed along the top back rail as at K in Fig. 31, to bring it up flush for fixing on the roof. The frame is now ready for boarding, the sides being done first. The boards should be cut one at a time, and nailed to the three rails, and should be fitted together as tight as possible. The central partition is made by nailing the boards to the two inner rails vertically. Next the floors should be laid, the boards being fixed on the upper side of the lower rails, flush at the back, but 1 in. from the front, as in Fig. 31, and running from back to front. The ceiling is done in the same way on the underside of the upper rails,

so as to give more space to the loft. The sloping boards of the roof are next put on, and should overhang 3 in. all round at the least. The back boards are put on vertically, like the sides.

For the doors, four pieces of the 2-in. by 1-in. stuff, 1 ft. 7 in. long, will be required, and four pieces 1 ft. 9 in. long; over the frames inside with large-head tacks or small staples, thin laths of wood being nailed over to cover the ends of the wire. Now place the doors in with the hinges folded, mark the uprights, and hinge on. They are kept shut with a revolving wood button, the one marked L in Figs. 30 and 34.

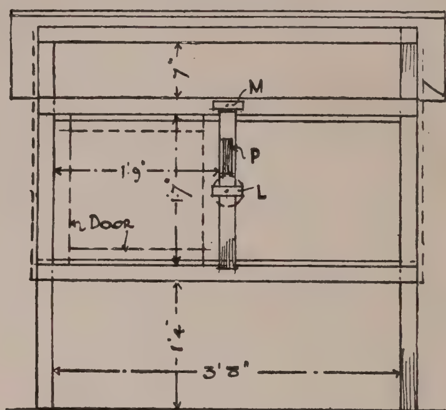


Fig. 30.—Front Elevation of Main Framework

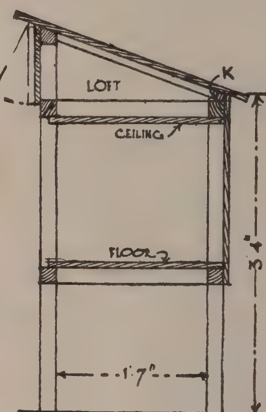


Fig. 31.—Section showing Framework Partly Boarded

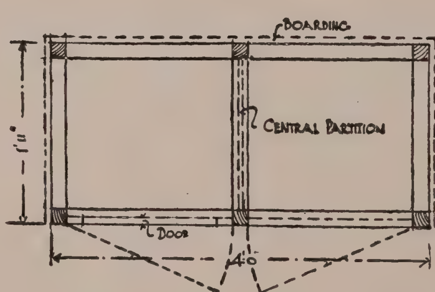


Fig. 32.—Plan of Framework

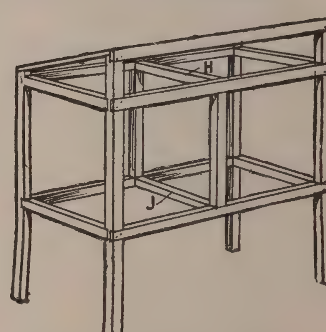


Fig. 33.—General View of Framework

these should be planed up and made into the frames, the joints being halved, glued, and screwed in the usual manner. They should be made to fit neatly but free, and hinged with 2-in. iron butt hinges, which must be let into the frames flush about 3 in. from the corners, with the round standing out. Some wire netting of about $1\frac{1}{2}$-in. mesh must be obtained; this is fixed

To make the loft door, a board the full length of the hutch, and $9\frac{1}{2}$ in. wide by $\frac{1}{2}$ in. thick, must be got out, and two battens nailed on at the extreme ends, on the outside, as in Fig. 34. It is then hinged under the overhanging part of the roof with 5 in. T–hinges, and is kept closed by another wood button M, which will require a piece of $\frac{1}{2}$-in. board fixed under it. A device

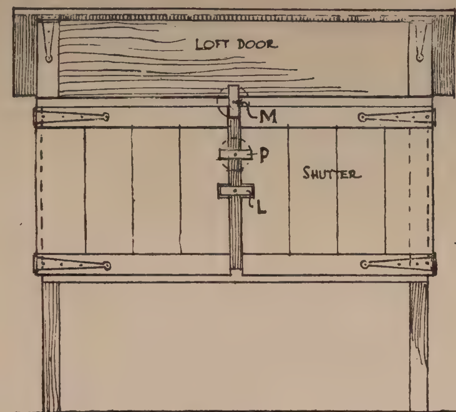


Fig. 34.—Front Elevation of Hutch with Shutters Closed

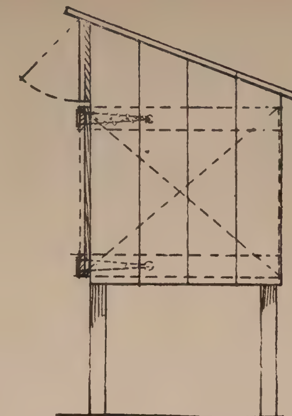


Fig. 36.—Side Elevation of Hutch

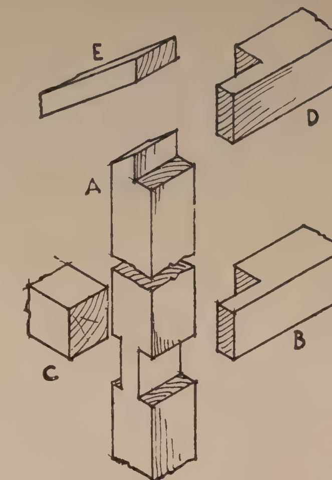


Fig. 37.—Details of Points of Framework

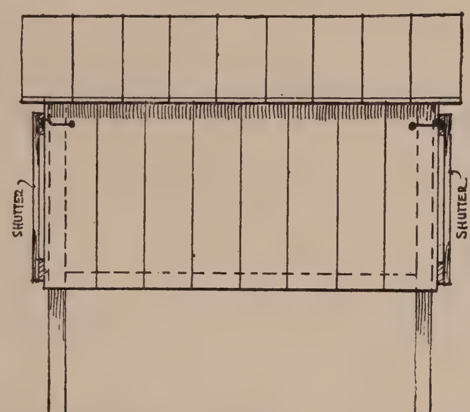


Fig. 35.—Back Elevation of Hutch with Shutters Open

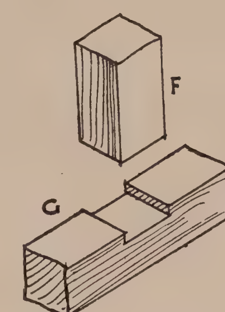


Fig. 38.—Joint for Division Pieces

Scale, ½ in. = 1 ft.

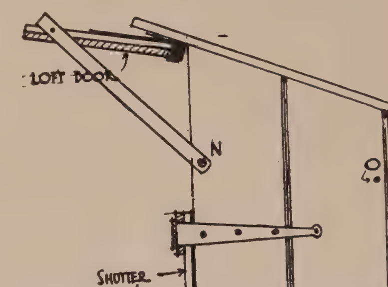


Fig. 39.—Arrangement of Loft Door

for propping it open is shown in Fig. 39. A strip of wood 1 ft. 2 in. by $1\frac{1}{2}$ in. by 1 in., or a metal lath, has one end screwed tight to the batten $2\frac{1}{2}$ in. from the corner; a screw is put in the side, as at N, and a hole made at the end of the prop large enough to pass over the screw-head. Another screw is put in farther back at O to take the prop when the loft is closed.

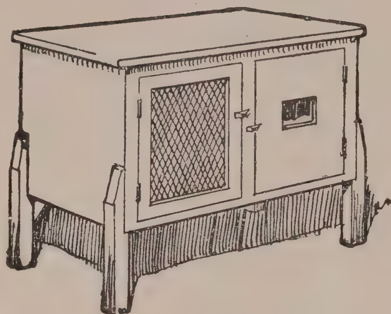


Fig. 40.—Perspective View of Ferret Hutch

Fig. 43.

Fig. 44.

Figs. 43 and 44.—Joints of Facing

Scale, $\frac{3}{4}$ in. = 1 ft.

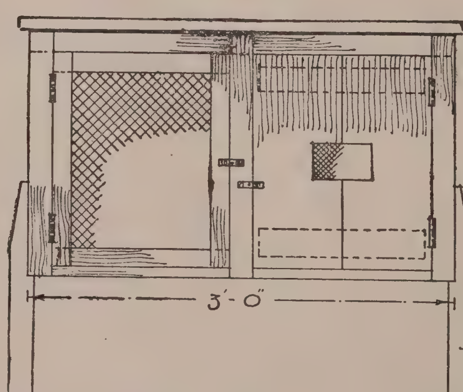


Fig. 41.—Front Elevation of Ferret Hutch

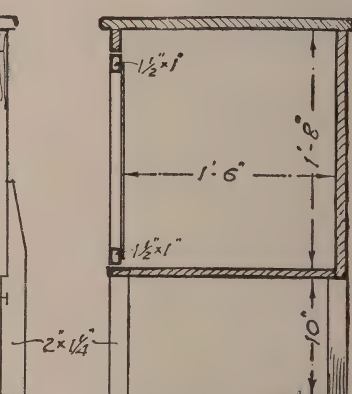


Fig. 42.—Cross Section

It is a good plan to bore a number of small drainage holes in the bottom of the hutch, and air holes should be made at the back as high as possible, and at the tops of the sides, to air the loft.

The outer doors or shutters are made by cutting the required number of boards 1 ft. $9\frac{1}{2}$ in. long; these are held together by battens, and hinged on with 9-in. back-lap strap hinges. It will be necessary to cut pieces out of the end boards to clear the button of the inner doors when closed, as indicated at L in Fig. 34. They are kept shut by the middle button P, which requires a piece of $\frac{1}{2}$-in. stuff behind it, and held open by hooks placed at the back of the hutch, as shown in Fig. 35, the eyes being fixed to the top battens of the shutters. The inside of the hutch should be lime-washed, and the outside given two or three coats of paint, this being necessary to preserve the wood and iron.

FERRET HUTCH

A ferret hutch that is easily constructed is shown above by Figs. 40, 41 and 42.

Obviously the difference between this and a rabbit hutch need not be very pronounced. The ends, back, floor, and top may be of $\frac{3}{4}$-in. matchboarding, or a suitable size packing-case may be used instead.

The hutch is divided into two compartments by means of a partition with a small hole in it, to enable the inmates to be kept to one part whilst the other is being cleaned. The facing on the front may be halved together, as in Figs. 43 and 44. The door on the left-hand half of the hutch is made of $1\frac{1}{2}$-in. by 1-in. rails, halved together and is filled in with fine wire netting and hinged as shown. The door on the right-hand half is made of boarding secured together with a couple of ledges, as dotted in Fig. 41, and a small hole is cut in the centre and covered with fine wire netting. These doors may be fastened with turnbuttons as shown, or with hooks and eyes. Four legs, which may be cut from 2-in. by $1\frac{1}{4}$-in. deal, are used to keep the hutch above the floor of the shed in which it may be placed.

It is an advantage to have the whole of the front to open as shown, and the door should be brought down to the floor of the hutch, as cleanliness is essential.

Dog Kennels

INDOOR DOG KENNELS

The illustrations (Figs. 1 to 7) show the construction of a dog-kennel provided with loose ends in order that it can easily be cleaned out. The ends are held in place by turn-buttons, and when removed a clean sweep can be made of the interior. The use of three-ply is a distinct advantage in the construction, as the smooth, level surface affords no lodgment for vermin.

First make three skeleton frames, each containing two uprights 2 ft. 6 in. long, 3 in. by $\frac{7}{8}$ in., planed, a bottom rail $22\frac{3}{4}$ in. long, 3 in. by $\frac{7}{8}$ in., and a top rail cut to the sweep of the roof out of a board 2 ft. 6 in. by $6\frac{1}{2}$ in. by $\frac{7}{8}$ in. Fig. 1 shows an upright trenched $\frac{1}{4}$ in. deep at the bottom to receive the bottom rail. The top edge of the trench is kept 3 in. from the floor. Half-way up shows where the side rail that holds the three frames in position is halved on (*see* Fig. 2). The slot in the top of the upright receives the top rail, and is cut down $4\frac{1}{4}$ in. by $\frac{5}{8}$ in. Fig. 3 shows how the top rail is marked for cutting from the board. First the three boards for the top rails are laid flat together on the bench, level at each end. Lay on the square, and mark a line 3 in. from each end. Lay the edge of an upright to these marks inside, and square through also; mark with a sharp point, not a pencil. The distance between the inside marks should be $22\frac{1}{4}$ in. Square the marks through the edges of each board, and return the marks along each side, so as to get them all equal; they are then ready for cutting to shape shown in Fig. 3.

Lay a piece of three-ply on the bench to form a drawing board. Then get a thin lath; a plasterer's lath is about the best thing to strike the radius. With a bradawl bore a hole 28 in. from one end, and another 32 in. Then lay a top rail on the drawing board, and with the bradawl stuck through the hole of the lath marked 28 in., strike the radius of the bottom edge of the top rail to just intersect at each shoulder. Then with the bradawl at 32 in. strike the radius from the same centre to mark the top line of the rail, which must be temporarily fastened down (*see* Fig. 4). The rails can then be sawn out to the lines and cleaned up, and the shoulders trenched $\frac{1}{8}$ in. deep each side shown at the dotted lines. This will allow the rails to slide into the $\frac{5}{8}$-in. slot cut in the uprights (*see* Fig. 5). The projecting lugs are gauged $\frac{7}{8}$ in. from the top edge, and cut to receive the top side rails, the remaining wood being cut to design.

Now, assuming that the uprights are all prepared like Fig. 1, the three skeleton frames can be nailed together; a $\frac{1}{4}$-in. bead run along the inside front edges would be an improvement, as the removable ends finish flush (*see* Fig. 6). The six side rails, 3 ft. long by 3 in. by $\frac{7}{8}$ in., are now required. Lay them all flat together level at the ends, mark 3-in. shoulder lines at each end, also in the centre, and square the marks through

each piece. The two top rails only require the back edges bevelling to fit up to their places. The two middle rails are halved to fit over each upright. The ply is nailed to the sides. Four fillets 13½ in. long, ⅞ in. square, are nailed flush outside to the bottom rails (*see* Fig. 2) to receive the edge of three-ply that

Fig. 1.—Upright Trenched to Receive Bottom Rail

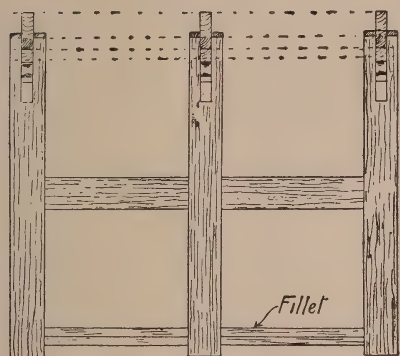


Fig. 2.—Framework of Side

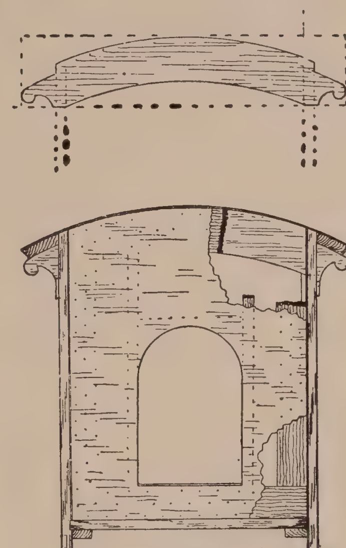


Fig. 3.—Top Rail and Front View of Kennel

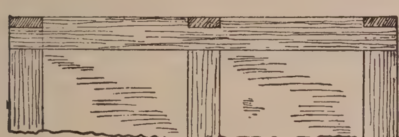


Fig. 7.—Bottom of Kennel

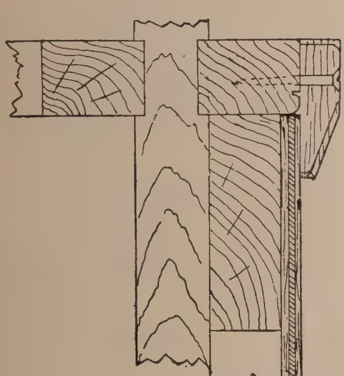


Fig. 6.—Section of Corner

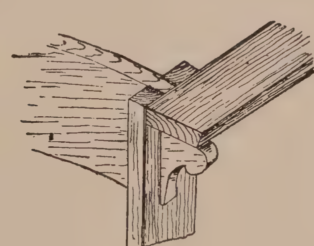


Fig. 5.—Detail of Top of Indoor Kennel

Fig. 4.—Method of Striking Curve of Top Rail

two bottom rails are notched out ⅞ in., and are nailed on the bottom to fit flush with the outside (*see* Fig. 7). Fasten the middle and bottom rails in position; the top rails are left off until the three-forms the floor of the kennel. Trim off any rough edges flush with the outside all round, then nail on the two sides. Do not go beyond the bottom rails, and see that the sides are kept high enough to

nail to the back edges of the top rails, which can then be nailed into their position with 2-in. oval wire nails.

The top is next fastened on, bent to the sweep, and nailed well to the side rails with 1-in. flat-head wire nails. Trim off all the rough edges, and make and fit the two ends. Halve the frames together to fit in between the two uprights and the top and bottom. Nail a small fillet down each upright in line with the top rail, for fixing the two end frames. These end frames are covered with three-ply, one having to be cut as shown in Fig. 3 to allow the dog to enter. It must be noted

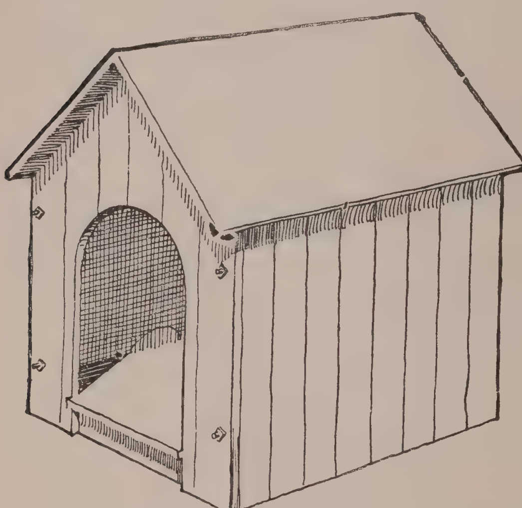


Fig. 8.—Portable Kennel

that $\frac{1}{2}$-in. fillets should be nailed to strengthen the edges wherever cut. See that it is well painted; three coats at least.

PORTABLE DOG KENNEL

A kennel of good, sound construction, and at the same time possessing the merit of being easily taken to pieces for purposes of transit, etc., is shown by Figs. 8 to 12. Grooved and tongued boarding 6 in. wide and 1 in. thick is a suitable material to use. The boards of the sides should be nailed to a $1\frac{1}{2}$-in. by 2-in. ledge at the top, and a 3-in. by $1\frac{1}{2}$-in. ledge at the bottom (*see* A and B, Fig. 9). The boards of the front and back should be nailed to similar ledges, as shown at C and D (Fig. 10). The boards forming each side of the roof should be nailed to the three bearers E (Fig. 9). The floor consists merely of several boards secured by means of a couple of ledges, as at F in Fig. 9. It will be seen that the kennel will be composed of seven main pieces. Fillets (to form angle pieces) about $1\frac{1}{2}$ in. by $1\frac{1}{2}$ in. should be nailed to each end of the sides, as shown at G in Figs. 9, 11 and 12. The latter is an enlarged section taken through H.

The front and back can be fixed to the sides by eight $2\frac{1}{4}$-in. by $\frac{1}{4}$-in. bolts and nuts, as shown by Figs. 8, 10 and 12. Each half of the roof can be fixed to the ends by eight bolts and nuts in a similar manner. The floor will rest on the ledges B (Fig. 9), round the bottom of the boarding.

The advantage of this bolted construction lies in the fact that the kennel can readily be packed flat if desired. Should such an arrangement not be desired the same general design will apply, using nails or screws in lieu of the small bolts. The roof should be covered with felt.

KENNEL WITH TWO COMPARTMENTS

Kennels are usually built with simply the one compartment, but that illustrated in Fig. 13 is of more elaborate construction, and is provided with day and night quarters. One end has a door which is useful in hot weather, and one side of the sleeping compartment is formed as a door. The dimensions given in Figs. 14 and 16 will be found suitable for an ordinary retriever, but, of course, the sizes can be increased or decreased as required. The most suitable wood for the kennel is sound red deal, and from the illustrations the lengths and sizes of the various pieces can be ascertained with very little trouble. First set out the four vertical posts for mortising, and the bottom rails for tenoning. The intermediate post A (Fig 15)

and the bottom rail should be lap-halved together. The top rail may be simply a piece of stuff $1\frac{1}{4}$ in. by $4\frac{1}{2}$ in., which should be planed to the bevel of the roof, as shown at B (Figs. 14 and 17). Each end of these rails should be sub-tenoned into the angle posts. Then the intermediate post A (Fig. 17) can be notched out at the back C so as to nail on this rail. The posts and rails should be fitted together, and, when satisfactory, the joints should be painted, put together, and secured by a few stout screws or nails.

For the floor of the kennel grooved-

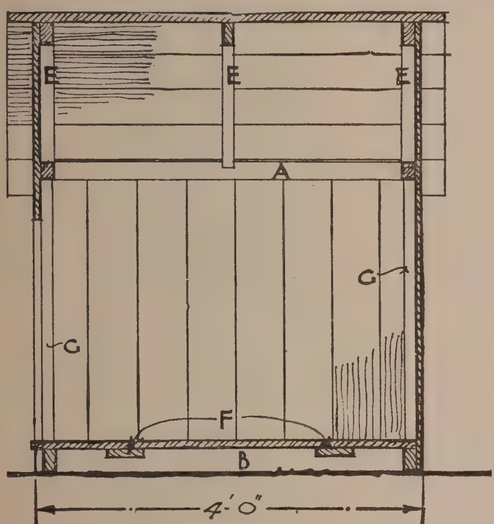


Fig. 9.—Longitudinal Section through Kennel

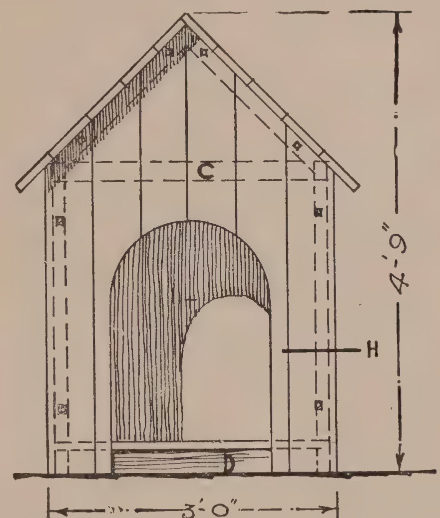


Fig. 10.—Front Elevation of Kennel

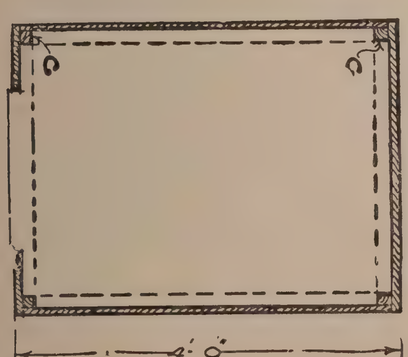


Fig. 11.—Horizontal Section through Kennel

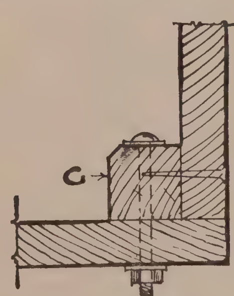


Fig. 12.—Details of Corner of Kennel

and-tongued boards will be satisfactory, and will not require to be specially supported. Except the case of the opening

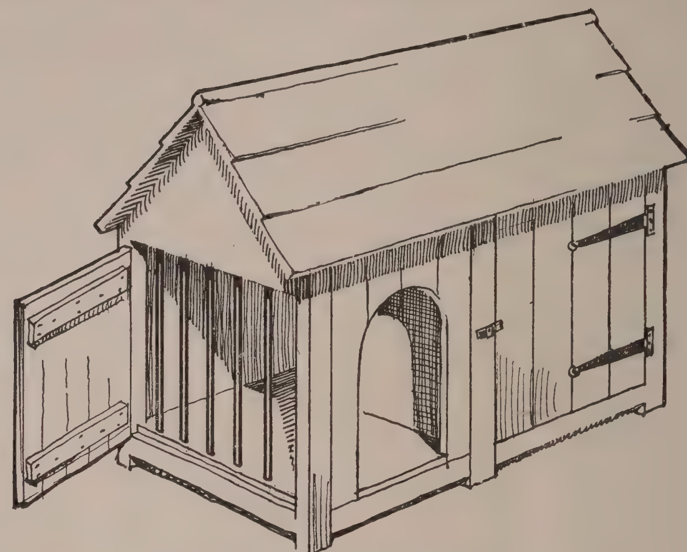


Fig. 13.—Two-compartment Kennel

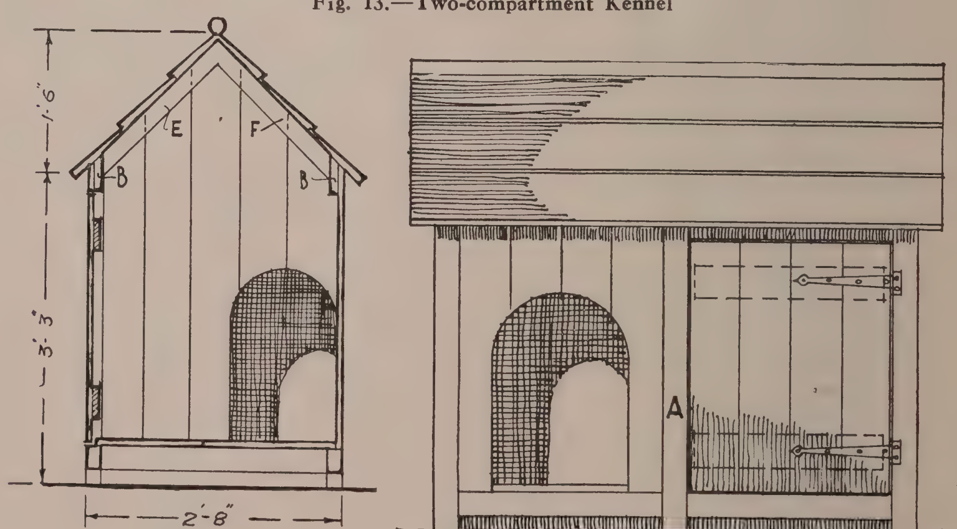


Fig. 14

Fig. 15

Figs. 14 and 15.—End and Side Elevations of Two-compartment Kennel

at D (Fig. 16), the boards should be kept back from the outer face of the bottom rails by a distance equal to the thickness of the board which is to form the sides. Therefore, obtain strips of breadth equal to the thickness of the boarding for the sides, and secure them with three or four small nails to the rails, just flush with the outside. Then the floorboards may be

cut to fit between these strips and nailed in position; after which the strips may be taken off and the right space will be left for the boarding of the sides.

Narrow matchboarding, about $\frac{3}{4}$ in. or $\frac{7}{8}$ in. thick, answers well for the sides, and must be cut to fit to the floorboards at the bottom and to the top rail. For the back it will be an advantage to cut the boards at a bevel; similarly cut those forming the opening in the front; then, after these boards are nailed in position, parts of the top ends projecting beyond the top rail may be planed flush. The boarding to form both the opening and closed ends should be cut to fit the bottom rail, and also the rake of the roof. The bottom ends, of course, will be secured to the floorboards and bottom rails. The upper ends of the two ledges E and F

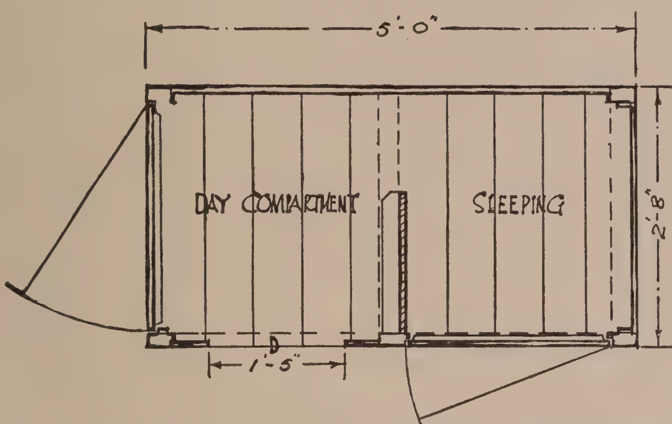


Fig. 16.—Horizontal Section through Two-compartment Kennel

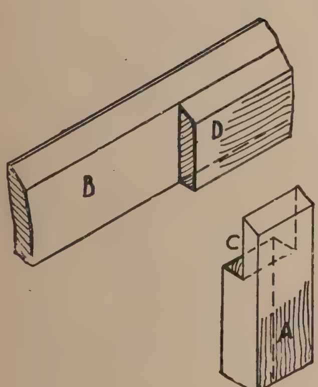


Fig. 17.—Joint Detail of Centre Post

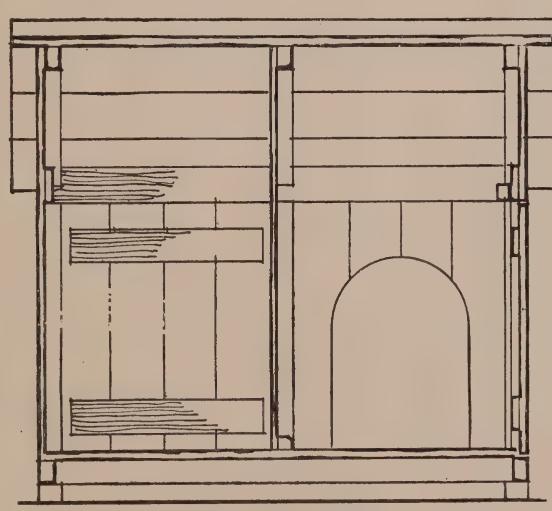


Fig. 18.—Longitudinal Section through Two-compartment Kennel

(Fig. 14) should be halved together and fixed to the top rails and angle posts. For the end that opens, the bottom end of the boards should be just tacked in position. Then, with a fine saw, cut along the line at G (Fig. 12), and the lower boards will form the door. This must have two ledges nailed on as dotted, and a ledge, also dotted, just above G should be nailed along the inside of the gable part, its lower edge projecting about $\frac{1}{2}$ in. below the ends of the boarding to answer as a stop. The partition, shown in Fig. 16, is simple, being fixed at the bottom to a fillet secured to the floor, and at the top to the central roof-bearers. The illustration makes the construction clear.

The door of the sleeping compartment is fully shown in Figs. 15 and 18. When this door is closed the top rail will not be flush with it, but this may be remedied by nailing on a piece of the same thickness as the door, as indicated at D (Fig. 17). The door should be hung with 12-in. cross garnets, and at the open end of the kennel five iron bars, about $\frac{5}{8}$ in. in diameter, are fitted in holes bored in a fillet at the bottom and in the ledge at the top. For the roof use 9-in. feather-edged boards, that is, $1\frac{1}{8}$ in. at the thick edge and $\frac{5}{8}$ in. at the thin edge, and rebate them together as indicated in Fig. 14. The top can be finished with a ridge roll prepared from $1\frac{3}{4}$-in. square stuff, rounded and **V**'d so as to fit over the top joint of the boards. To stand the weather well the kennel should have at least three coats of oil and white-lead paint.

Beehive and Fittings

The hive shown in the photograph (Fig. 1) is of the bar-frame variety and based upon the well-known "W. B. C." hives. Practically every dimension required for carrying out the work is given in the detailed illustrations of the various parts; it is necessary that these be strictly followed in order to accommodate the standard size of frames, and to ensure the proper fitting together of the whole. The construction employed may be of the most elementary character, but it will naturally prove a much more satisfactory job if the work is carefully executed, more particularly with regard to the tongueing and grooving together of boards for the flat surfaces and the use of dovetailing for the angles throughout.

The component parts are shown in their proper relationship but separated in Figs. 2 to 4, and working from the bottom are as follow:—

Fig. 1.—General View of Hive

Floorboard and Stand.—This is explained by Fig. 6, and consists of a flat board and sloping alighting board, both $\frac{1}{2}$ in. thick, nailed to shaped battens $2\frac{1}{2}$ in. by $1\frac{1}{2}$ in. (A Fig. 2), with shorter ones framed into them at front and back as shown in section in the same figure. Four stout legs sloped and notched, as in Fig. 7, should be firmly screwed on to complete this portion of the hive.

Outer Case.—(Fig. 8.) The inside measurements of this should be 1 ft. $5\frac{7}{8}$ in. by 1 ft. $7\frac{1}{4}$ in., and a plinth dropping $\frac{1}{2}$ in., chamfered and slightly rebated, as in Fig. 9, should be mitred round. The construction of the porch will be apparent on

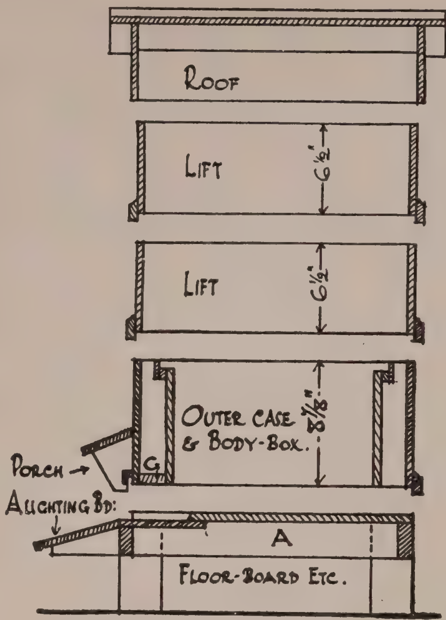


Fig. 2.

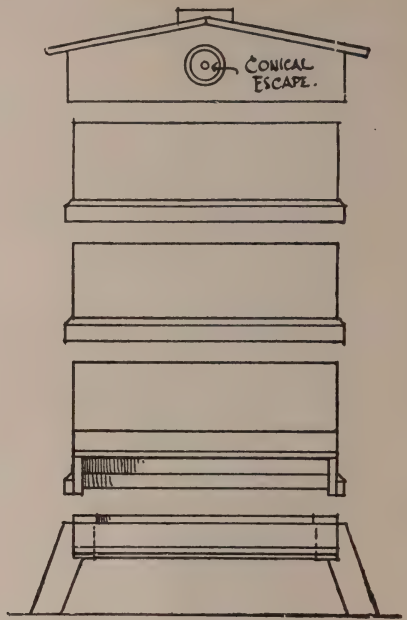


Fig. 3.

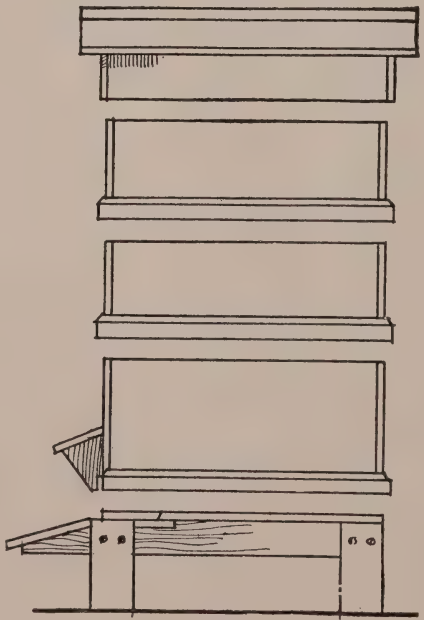


Fig. 4.

Figs. 2, 3 and 4.—Section and Front and Side Elevations of Bar-frame Beehive with Various Parts Separated

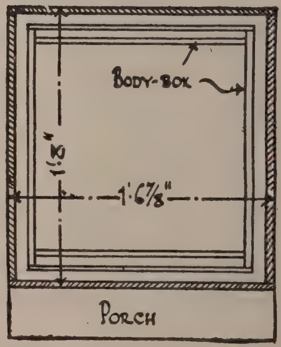


Fig. 5.—Horizontal Section through Body-box and Outer Walls

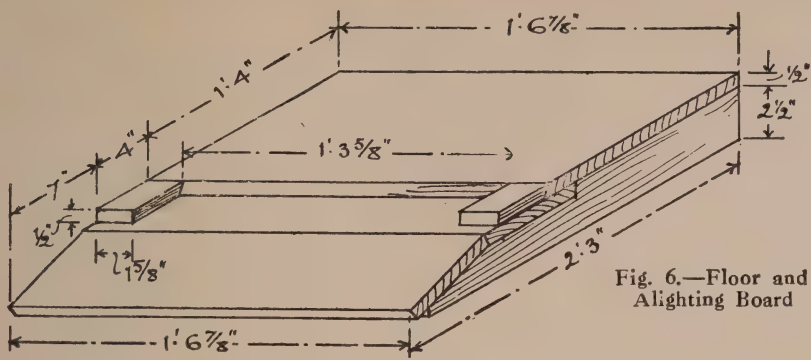


Fig. 6.—Floor and Alighting Board

reference to Fig. 10. It may be grooved at B to throw off the rain, or the whole could be sloped a little toward the ends. The entrance can be closed by means of two slides 10 in. long working in a groove formed by a rebated strip, or two separate pieces as illustrated.

Lift. — (Fig. 11.) This rests on the outer case and will be required in duplicate as shown. In this instance the plinth is continued all round.

Roof.—(Fig. 12.) This fits over the upper lift or outer case as required, and the lower inner edges of the sides should be rebated, as in Fig. 13. The overhanging boarding and ridge-piece are seen in Fig. 3 and can be covered with zinc or felt. For ventilation, holes should be bored in the gable-ends of the roof and fitted with perforated conical bee-escapes to allow

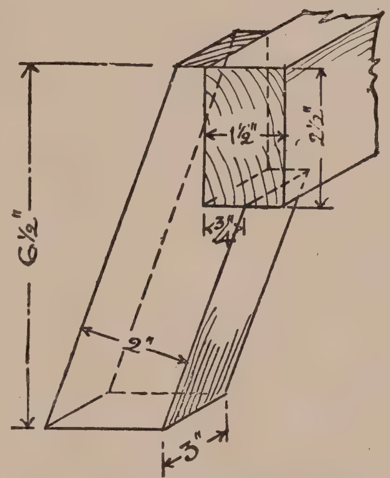


Fig. 7.—Detail of Leg and Support

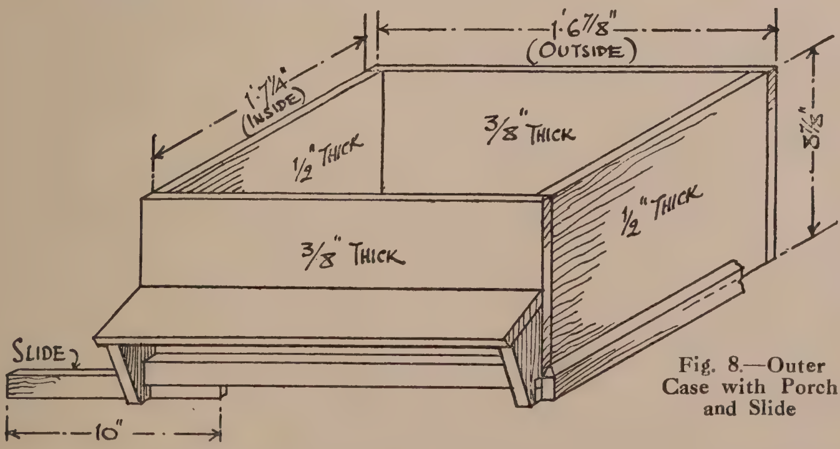


Fig. 8.—Outer Case with Porch and Slide

the exit of any bees that happen to get above the quilt which is usually placed over the frames.

Body-box or Brood-chamber.—This is shown in Fig. 14 and a horizontal section is given by Fig. 5. It is constructed to hold ten standard frames and should be 1 ft. 2½ in. by 1 ft. 3 in. main inside measurements. The front and back pieces fit into grooves ⅞ in. from the ends of the side pieces, as in Fig. 15. From each top corner of the latter a piece is notched to receive strips of wood, as at D D in Figs. 14 and 16. These strips enclose the top of the bar-frame ends, keeping them in position, and a strip, as at E in Fig. 16, is nailed between them and the front and back pieces. A strip of zinc (F Fig. 16) is nailed on at the front and back: it is on this that the frames rest in the manner indicated by the dotted lines. A loose piece of wood, as at G in Fig. 2, should be fitted loosely in order to prevent any bees getting into the cavity between the inner and outer compartments.

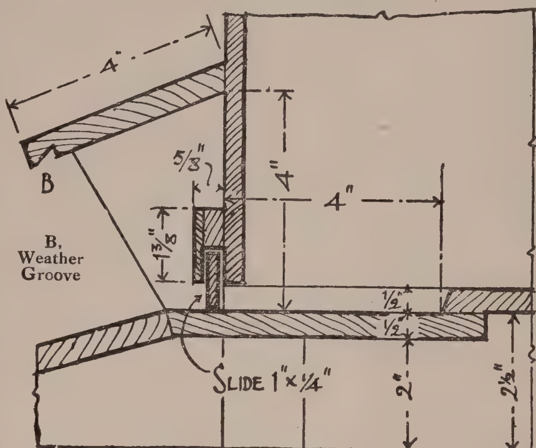


Fig. 10.—Section through Porch, Slide, etc.

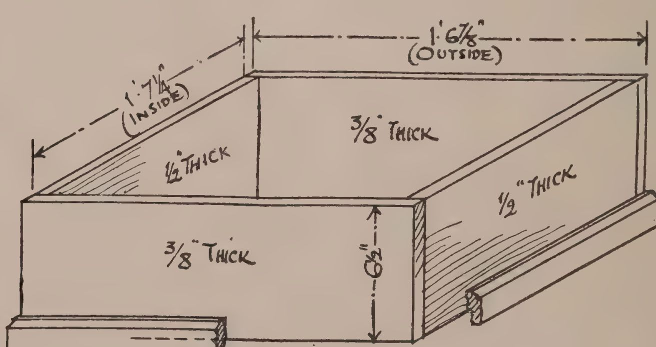


Fig. 11.—Construction of Lift

Fig. 9.—Section through Plinth to Outer Case and Lifts

Frame-Box or Super.—(Fig. 17). Except that it is only 6 in. deep this is exactly similar to the body-box over which it fits. The bar-frames to suit it are 5½ in. deep.

Eke.—(Fig. 18). This is intended for winter use only. Many bee-keepers find it possible entirely to dispense with this. It goes below the body-box and has four cleats, as shown, to keep it in position. It is used to raise the body-box to give bottom ventilation when wintering the bees; it can also be placed below the frame-box in order to bring it to the size of the body-box.

Fittings.—In a bar-frame or movable-comb hive it is important that each comb be built straight in its frame, and that each frame be squarely in position and capable of being lifted from the hive without tearing any attachment to another

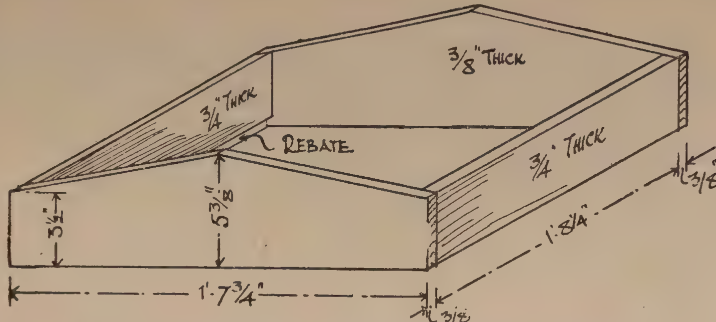


Fig. 12.—Construction of Roof without Top Boarding

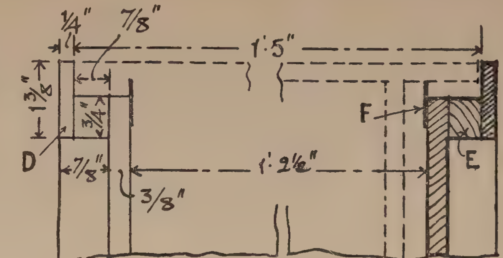


Fig. 16.—Detail Section through Top of Body-box

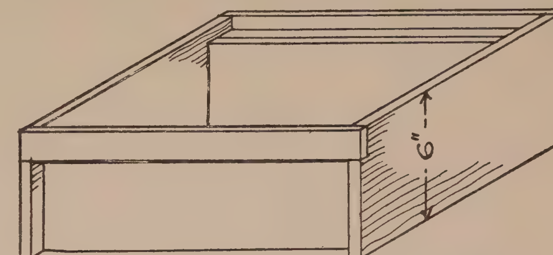


Fig. 17.—Construction of Frame-box or Super

D, Wood Strips
E, Distance Piece
F, Zinc Strip

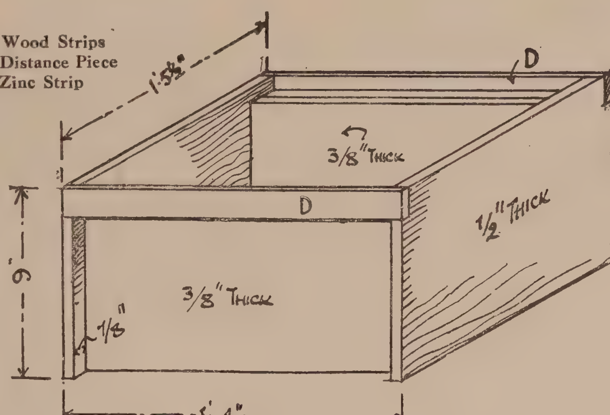


Fig. 14.—Body-box or Brood Chamber

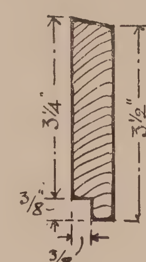


Fig. 13.—Section Through Side of Roof

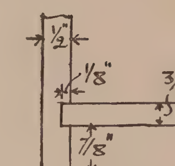


Fig. 15.—Front or Back of Body-box Grooved into Sides

comb or the hive walls. The first requisite is a set of frames, each to eventually contain comb. The standard frame of the British Bee-keepers' Association is illustrated by Fig. 19, and provided that the measurements there given are adhered to the pattern of the frames does not much matter; it will vary according to the method of spacing employed. In a natural state bees build their combs from $1\frac{1}{4}$ in. to $1\frac{1}{2}$ in. apart centre to centre, and the spacing usually adopted in placing frames is $1\frac{9}{20}$ in. centre to centre, ten frames thus occupying $14\frac{1}{2}$ in. Frames are either "broad shouldered," which are self-spacing or shoulderless, these latter requiring some mechanical contrivance to ensure correct spacing. It is hardly

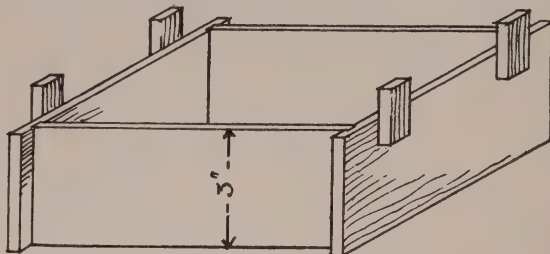


Fig. 18.—Construction of Eke

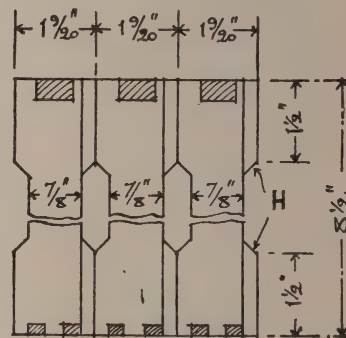


Fig. 20.

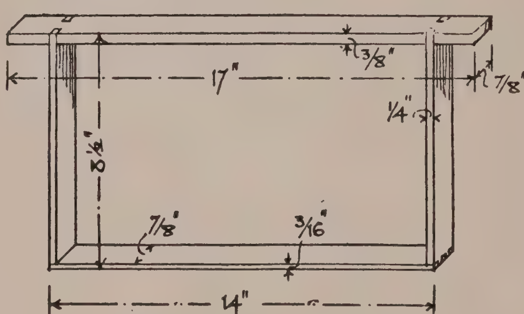


Fig. 19.—Standard-size Frame

Fig. 21.

Figs. 20 and 21.—End Elevation and Part Plan of Three Frames

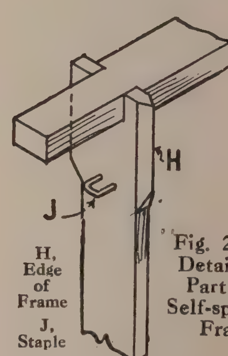


Fig. 22.—Detail of Part of Self-spacing Frame

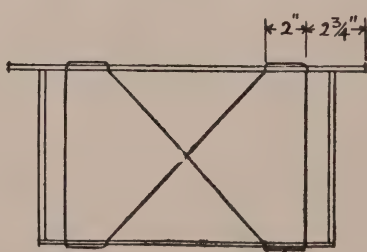


Fig. 23.—Frame Wired for Wax Foundation

worth while to make them when they can be purchased very readily, but if desired they can be made as in Fig. 19 and fitted with metal self-spacing ends attached to the top bar. There are several patterns of such fittings which obviate any likelihood of the bees gluing the frames together, but an efficient all-wood self-spacing frame can be made as shown in Figs. 20 to 22. Here the uprights are shouldered top and bottom to the regulation width of $1\frac{9}{20}$ in., and finished on one side to what is practically a knife-edge, as at H in all three figures. By this means they are kept strictly in the correct relationship. In order to prevent injury to any bees by squeezing between the hive-side and a frame, small staples, as at J in Fig. 22, should be driven in and left projecting $\frac{1}{4}$ in. near the top and bottom of each side. To induce the bees to build in the bar-frames instead of across them, it is necessary to use sheets of foundation wax, impressed with the bases of the cells. This sheet of wax can be fixed by running molten wax along the junction with the wood, but a much more satisfactory plan is to wire them, as in Fig. 23, the wires being heated and bedded

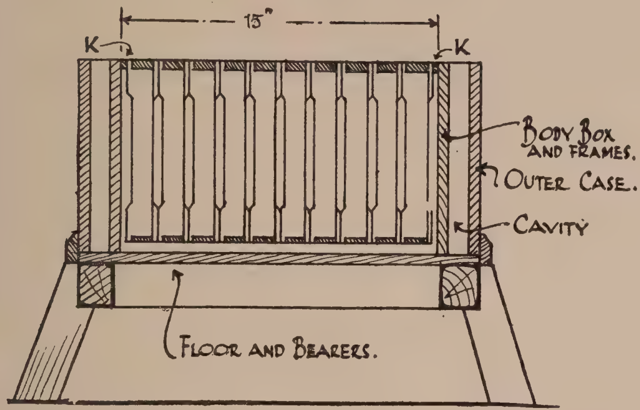
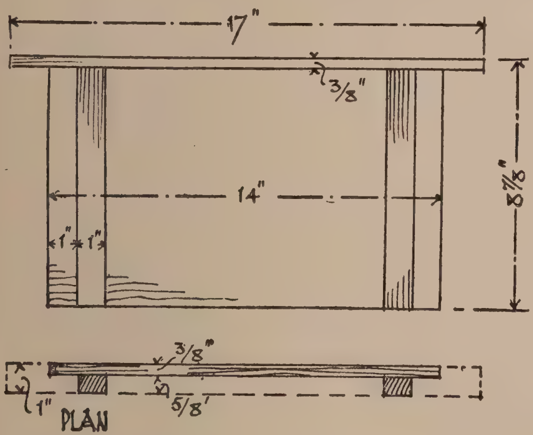


Fig. 24.—Section through Body-box Fitted with Frames



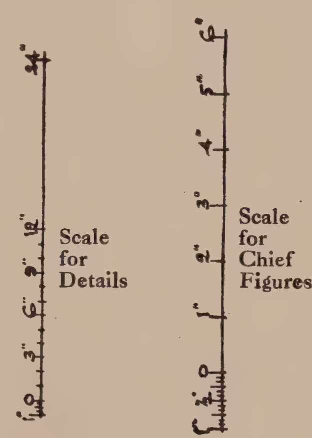


Fig. 25.—Elevation and Plan of "Dummy"

in the wax. No. 30 tinned iron wire should be used, threaded through holes in the centre of the frame and drawn tight and twisted round a small tack at the bottom, care being taken that the frame is not strained out of the square. For attaching the foundation the guide-board (Fig. 24) is necessary ; it is $\frac{3}{8}$ in. thick and $\frac{1}{8}$ in. less each way than the inside of the frames, and to its underside are fixed two fillets projecting $\frac{1}{4}$ in. at least on either side. On this board a sheet of wax foundation is laid with a wired frame above it. Then a tool called an embedder or some substitute is heated just sufficiently and run along the wires ; as the wax melts the wires are pressed into the sheet, in which they are firmly bedded when the wax cools.

Two plain strips of wood, $\frac{3}{8}$ in. by $\frac{1}{4}$ in., as at K K in Fig. 24, are necessary in order to increase the distance between each outer comb and the hive side of the "dummy" if one is in use. A dummy is a cleated or clamped board, fitting the inside of the hive, and having a top bar by means of which it can be suspended in the same way as a frame. Its purpose is to contract the brood nest when it is desired to give the bees a lesser number of frames. The usual form of dummy is explained by Fig. 25, and it should be an easy fit inside the hive.

To prevent the queen bee getting up into the sections, "excluder zinc" pierced with small slots through which only the workers can pass is used over the brood-nest. This can be obtained in sheets 16 in. square and is laid over the frames. Quilts are necessary for covering the frames, and for them nothing is better than thick american cloth laid on face down. Over this a number of thicknesses of carpet or sacking should be placed in order to keep the hive warm.

Steps and Ladders

HOUSEHOLD STEPS

HOUSEHOLD steps are of various kinds, but there is no doubt that for a serviceable article one cannot do better than make the solid variety.

Fig. 1.—Side View of Steps

Figs. 1 and 2 show a pair of steps of this kind. The steps as shown stand 6 ft. 9 in. high, but this is somewhat higher than usual, and may be reduced by one or more

Fig. 2.—Back View of Steps

steps. The best material to use for the steps is good sound yellow deal. Approxi-

mately 1 in. ($\frac{7}{8}$ in. really) will be the right thickness, and 9 in. will be a convenient width to obtain. This will cut down the middle for the sides, and the framing for the back legs will come off the side of the treads. The correct angle may be taken from the side elevation (Fig. 3) both for the steps and for the back legs. The latter, as shown, should be shorter than the former, so that they will not project inconveniently backwards when in use.

The front and back elevations of the finished steps are given in Figs. 4 and 5, the latter being minus the back legs, which are shown separately by Fig. 6. As shown in Figs. 4 and 5, the actual steps are fixed in slots cut in the sides, and are held there with nails. Sometimes two or three of the steps are tenoned through the sides and wedged; but there is no advantage in doing this, the nails answering all purposes, and the sides are not weakened.

When the wood has been cut to size and planed up, the necessary setting out can be proceeded with. To do this, lay the two sides on the bench side by side, with the best edges facing each other, as in Fig. 7, make the mark for the bottom of the steps, as on the right, pairing them as shown. From these marks—measuring at right angles—set off 9 in., and continue marking off the same distance along the whole length of the sides. These marks represent the tops of the steps, and therefore in order to get the width of the trenches measure $\frac{7}{8}$ in. from each of those numbered one to eight, towards the left. The extreme left-hand mark being the bottom of the steps is correct as it is, while that at the extreme right is the top of the steps, and thus requires cutting off $\frac{7}{8}$ in. shorter to allow for the top board. This latter, however, will be stronger if the sides are housed into it. Therefore, instead of making the mark $\frac{7}{8}$ in. to the left, make it $\frac{5}{8}$ in. only.

The above marks must now be squared across the edges, and a gauge mark made for the depth of the trenches ($\frac{1}{4}$ in.), when the sides will appear as Fig. 8. The ends of the sides can now be sawn off to the respective marks, the trenches sawn in, and the wood removed down to the gauge marks with a sharp chisel (see Fig. 9). To obtain the correct length of the treads (steps), take a piece of board, make eight marks along it at equal distances apart, as the numbered lines in Fig. 10, and one more the same distance. On the lower line set off the width of the finished steps at the bottom (18 in.), and on the extra line set off the width at the top (13 in.); connect these lines as shown, and measure off $\frac{5}{8}$ in. inwards from each. On connecting these latter lines, the correct length of each step will be given.

The treads may be cut off at a right angle, both flatwise and edgewise, the very slight taper of the steps being negligible, and when tightly nailed the fit will be all that can be desired. The treads can now be driven into the trenches, keeping the bottom corner of each level with the front edge of the string, and inserting three nails in each, carefully driving them on the skew so that they will have the maximum holding power. After all the treads are nailed, the projecting front corner of each tread can be neatly chamfered out, as shown in Fig. 4, and the treads at the back must be planed off level with the edges of the strings.

The back legs must now be framed. The stiles (sides) are shown set out for mortising in Fig. 11; the mortises must be slightly on the bevel, as shown, and they must be made slightly wider on the outside (as on the right) to allow of the insertion of the fixing wedges. The top and bottom rails are shown in Figs. 12 and 13 respectively. The angle of the shoulders is the same as that formed by the treads and the sides in Fig. 5, and the length must be such as to bring the full width the same as that of the steps themselves.

The top board is shown by Fig. 14, trenched ready for fixing to the steps. The trenching is marked by laying the top on in its correct position, and marking round, cutting out to the marks to the depth of $\frac{1}{4}$ in. The top board should be rounded on all four edges, as shown in Figs. 3, 4, and 5. The backboard A (Fig. 5) is simply nailed on to the back of the sides in the position shown, and to

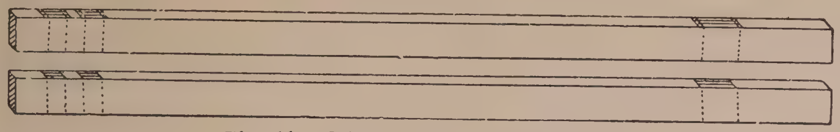


Fig. 11.—Stiles of Back Legs Set Out

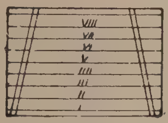


Fig. 10.—Obtaining Length of Treads

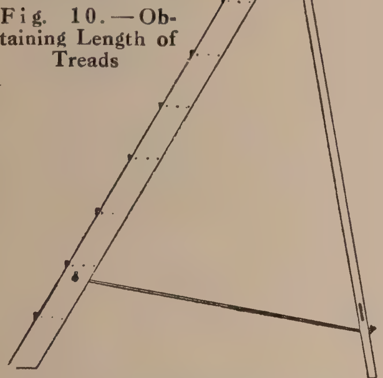


Fig. 3.—Side Elevation of Steps

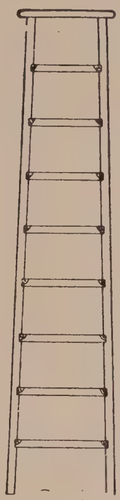


Fig. 4

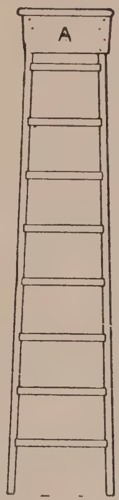


Fig. 5.

Figs. 4 and 5.—Front and Back Elevation of Step Part

Fig. 6.—Back Legs

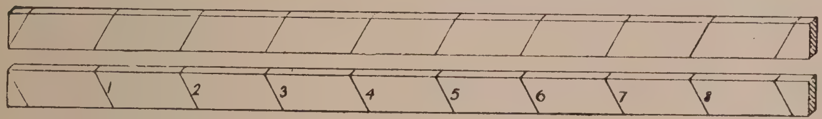


Fig. 7.

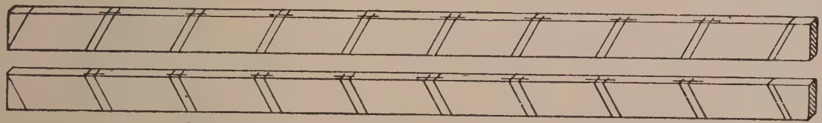


Fig. 8.

Figs. 7 and 8.—Sides Partly and Completely Set Out

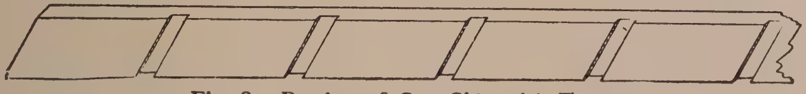


Fig. 9.—Portion of One Side with Trenches

Fig. 12.

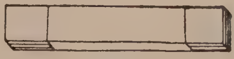


Fig. 13.

Figs. 12 and 13.—Top and Bottom Rail of Back Legs

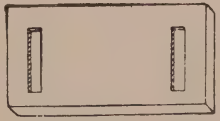


Fig. 14.—Top Board Trenched

it the back legs are hinged. This will practically finish the steps. The hinges used should be what are called back-flaps, and made from wrought-iron. The stretching cords should be fixed, as shown in Fig. 3, the reason for fixing the one end low in the back legs being to prevent the latter from bending when the steps are in use. The cords should be regulated in length so that when they are tightly stretched the treads are level.

HOUSEHOLD FOLDING STEPS

Folding steps are lighter and more easily constructed than the solid kind. Fig. 15 is a perspective view of the steps when in use, the height being 4 ft. 6 in. Fig. 16 shows them closed up. The steps can be made of deal or birch. The sizes given are for birch ; but if deal is used the parts should be a trifle heavier. It is advisable in the larger steps to have the main rails of birch or hardwood, to ensure the strength necessary to the increased length. All the working joints are washered and riveted.

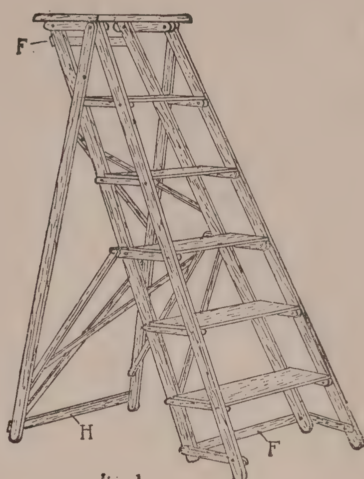


Fig. 15.—General View of Steps

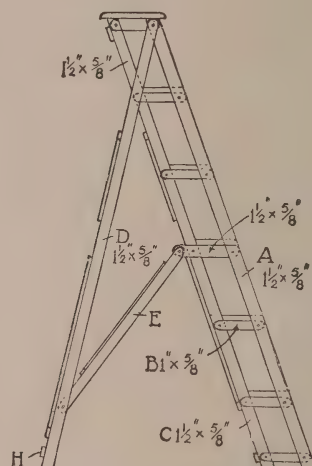


Fig. 17.—Side Elevation of Steps

Fig. 16.—Steps Folded Up

Fig. 19.—Position of Rivet Holes

Fig. 18.—Shape of Ends

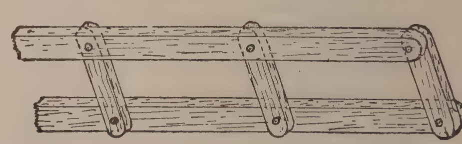


Fig. 20.—Method of Riveting Sides Together

Fig. 17 is a side view of the steps, showing the angle of them when in use, and also the sizes of the various members. It should be noticed that when the steps fold up the back rails C and the tread

bearers B with the treads practically fit between the front rails A. When folded up the back rails C rise and swing forward. The main rails of the back frame D are the widest, and fold to the outside of A. The middle tread bearer is stronger, and has a projection $1\frac{1}{2}$ in. longer than the others to receive the thrust of the back struts E.

First prepare the four rails A and C, 5 ft. 1 in. long, to the sizes shown. Round all ends to a semicircle, as shown by Fig. 18, to facilitate the folding arrangement. Then do the same to the tread bearers B, which, with the exception of the middle two, are 6 in. long, the two at the top being the same length but stronger. Now with a spoon-bit bore all holes for $\frac{3}{16}$-in. rivets, measuring from the top ends of the rails A and C. The first hole is in the centre of the semicircle, and a 10 in. space will equally divide for six treads, as in Fig. 19. Then bore holes in bearers B $4\frac{3}{4}$ in. apart. Rivet the bearers to the rails to form sides, as shown in Fig. 20. The rivets should be cut from a $\frac{3}{16}$-in. iron rod. Three washers are required for each joint, one between the joint and one each side. As only a small amount of riveting is necessary, the rivets should be cut off close to the washers and lightly hammered over.

The two back pieces F (Fig. 15) are screwed on to secure the width of the steps, which should be 12 in. outside width at the top of the rails A and 18 in. at the bottom. Next prepare and screw on all treads excepting the top; they are of $\frac{3}{8}$-in. birch boards $4\frac{3}{4}$ in. wide. Fig. 15 clearly shows how they are fitted between the front rails, and are made flush at the ends with the bearers. The top front edges of the treads should be chamfered or rounded off before fixing. The main rails for the back frame D are 4 ft. 7 in. long. The ends are rounded, and they are then riveted to the outside top of the front rails with the top tread bearers. Now folding these into position gives the width, therefore the bottom bar H can be fixed.

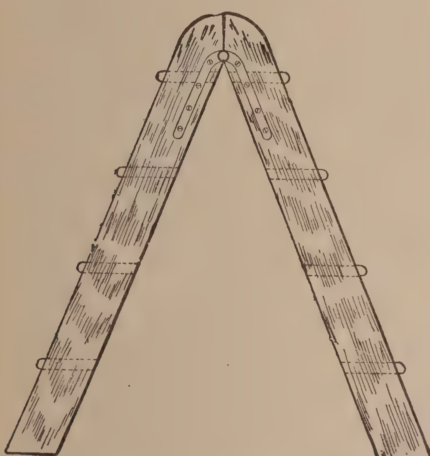


Fig. 21.—Side Elevation of Double Folding Steps

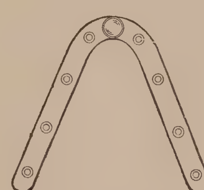


Fig. 23.—Hinge for Folding Steps

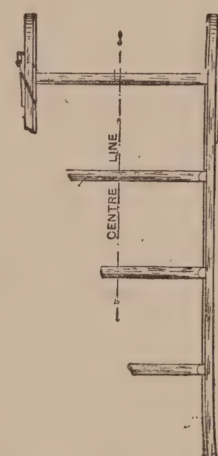


Fig. 22.—Part Front Elevation of Folding Steps

The struts E should next be fixed to projecting middle bearers, and the position ascertained for the lower rivet, which will be about 7 in. from the end of the back rails D. A good plan will be to close the steps and temporarily fasten the lower ends of the struts with screws. Then test by opening for correct position or

inclination of the steps, and rivet accordingly. Braces are diagonally fixed with screws at the back to prevent distortion of the frames. These are five in number, and need only be of lighter material, $\frac{3}{4}$ in. by $\frac{5}{8}$ in. First fix one across the struts E, then close the steps and fasten two to the main steps and two to the back frame, allowing sufficient room for clearance. The top tread, 13 in. by $6\frac{1}{2}$ in. by $\frac{3}{8}$ in., can now be fastened on, and two extra bearers at the foot of the rails will strengthen same. These are riveted on the same as the others.

PAIR OF DOUBLE FOLDING STEPS

The double folding steps shown in side elevation by Fig. 21 and part front elevation by Fig. 22 can be made of $\frac{7}{8}$-in. deal. The two halves of the steps are made separately, and are joined together by two hinges at the top; the portion of the steps projecting above the hinges act as stops when the steps are open.

The sides are $4\frac{1}{2}$ in. wide. There are four steps $5\frac{1}{2}$ in. wide, the distance between each step being 8 in., and the distance from the top of the top step to the top of the sides is $5\frac{1}{2}$ in. The top and bottom steps are grooved $\frac{1}{4}$ in. and tenoned into the sides, and the middle steps are grooved into the sides, the whole being fastened together with nails. The width of the steps over the sides is 1 ft. 6 in., and the length over the sides at the bottom when open is 3 ft. 3 in. The hinges (Fig. 23) are of $\frac{7}{8}$-in. half-round iron fixed to the sides with screws. Each half of the hinge is 9 in. long, and they are fastened together with a $\frac{3}{8}$-in. rivet in the centre on which they work.

MAKING A LADDER

Ladders are of two kinds. One is made from an ordinary batten sawn through the middle, and the other from a pole cut through in the same way. The latter is the better. In the former case, the batten is cut out of a tree, and the grain of the wood is certain to be cut asunder in places. In cutting it up to form the sides of a ladder it is cut again. In the case of a pole, the saw-cut runs up the pith, and thus follows the grain of the wood instead of crossing it. Thus a ladder made from a pole is much stronger than one twice as stout made from a batten; and as lightness is a very necessary condition, the balance is in favour of pole sides in every way.

These poles are sold at all timber-yards for ladder making and scaffolding, and in choosing, pick one on which the bark is left, as those which have been peeled are very apt to be partly decayed. After choosing the pole, get it cut up the middle on the saw-bench, as it is not a nice job to do with the hand-saw, and it will be done at the yard much better. Having obtained the pole, the staves are next required. These can usually be obtained ready-made of oak, though spanish chestnut is good if cleft out of poles. As oak staves would be made in the same way, except that they would be cleft out of larger timber, it is supposed that chestnut staves are to be used. For a ladder 20 ft. long twenty-five staves will be required. Therefore, procure some chestnut poles from 4 in. to 5 in. in diameter, and cut off seven lengths, varying from 1 ft. 1 in. to 1 ft. 6 in. long, cutting the largest poles into the longest lengths; then cleave them through, as shown by the lines A (Fig. 24). The ring B represents the sap, which should all be chopped away, as it soon rots. The four circles C show the four staves which can be made out of each length. When all are cleft out, they must be chopped up roughly, first square, then the corners taken off so as to make them eight-sided. They should vary in size from $1\frac{1}{4}$ in. in the middle and $\frac{7}{8}$ in. at the ends for the longest, to 1 in. in the middle and $\frac{5}{8}$ in. at the ends for the shortest. Some prefer to make them parallel throughout; but it is better to have them stouter in the middle, where the wear and bending stress comes.

The staves can either be finished with the jack-plane, and left eight-sided, or they can be made round. A useful tool for rounding them (assuming a lathe is not

available) is a plane as shown by Fig. 25. It is really a smoothing plane with a hollow face and iron. The best way to use it is to drive a peg into a post diagonally, about 3 ft. from the ground, as at D (Fig. 26), leaving it projecting about 9 in., and into the end drive a nail, leaving it about $\frac{1}{2}$ in. out; this must be sharpened to a point. One end of the stave is pushed against this point, and the other held against the breast, while the stave is rounded, turning the latter round in the process, and reversing the ends when necessary. By this means the staves can be rounded very easily and quickly, and they look as well as the turned ones.

Both the sides and the staves being ready, begin on the ladder. Take a pair of trestles, and lay the two sides on them flatside uppermost. They should be fixed about 1 ft. apart, so as to leave room to get between them. Bore a hole close to the large end of each side, through trestle and all, and insert a pin so that the sides are held in position for later operation. The pins are shown at E (Fig. 27), and one of them at E (Fig. 28). Now make a centre line up each side, as shown in Fig. 27 (if the plane is just run over it will be all the better), and then cut a small strip of wood 9 in. long, and mark the places for the staves, starting just clear of the pins E. The sides must now be bored, using a $\frac{3}{4}$-in. twist-bit for the bottom twelve holes or so, and a $\frac{5}{8}$-in. bit for the remainder. The best way to bore them so as to get the ladder out of twist, is to stride the side, and then bore one hole, and miss one for the whole length of the side; then, on getting to the other end, turn round, and bore at the marks which were missed, facing the opposite way. By this means, if there is a tendency to bore out of the upright, one hole will counteract the other.

Both sides being bored, the staves must be taken in hand. Lay them all side by side on a bench, or any flat surface, graduating them from the longest and stoutest to the smallest and shortest. Then mark 12 in. on the longest, leaving about an equal length at each end, and 8 in. on the shortest, and with a straightedge make marks on the whole lot from one to the other; then, without moving them, number each stave as it lies, starting at the longest, or bottom stave, and finishing at the shortest, or top stave. Fig. 29 shows the bottom one, and Fig. 30 the top, the rest lying between them; the marks are shown at F in both figures.

A very useful tool now required is a bung-borer (Fig. 31), by means of which the holes are reamed out until each stave will fit in its proper place up to the marks F. If a taper auger is not available, an alternate method of fitting them is to bore a hole in a waste piece of wood with the same bits as were used for the sides; then cut away the wood of the staves from the marks F to the end, as shown by the dotted lines at G (Fig. 29), making a kind of shoulder until they fit into the hole the necessary distance. This is best done with a drawing-knife, although it can be done with a chisel; they must be made loose enough so that they can be pushed in with the hand, or the sides of the ladder will split when driving it together.

Having fitted all the staves, they can be driven into one of the sides, taking care to keep the numbers correct; the other side can be placed on the staves, entering them one by one into their holes. Then drive it on home, when most likely, if the staves are carefully fitted, both sides will be straight sidewise; and if the holes are bored correctly, the ladder will be out of winding. But if it is not so, do not attempt to alter it yet. The sides now require to be fastened on in some way, or the ladder will soon come to pieces. Some prefer to wedge each stave at both ends. If it is decided to do this the projecting ends of the staves must be split with a chisel at right angles to the side of the ladder, as at H (Fig. 32), and oak wedges driven in tightly. Do not split them in the same direction as the side runs or they will split when the wedges are inserted. But the better way to fix the ladder together is to bore a $\frac{1}{4}$-in. hole through the side and stave at intervals of about six staves, and insert a pin. There is no fear of the pins drawing out, and there is a great chance of the wedges doing so.

The ladder can now be taken off the pin E, turned flat on the trestles, and the end of the staves cut off level with the outside of the sides. The bark can also be taken off, and all knots and other projections trimmed off with the jack-plane, which tool can be also used to chamfer off the sharp edge, as shown in

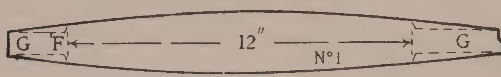


Fig. 29.—Bottom Stave or Rung

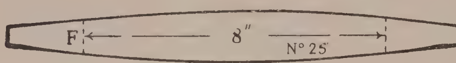


Fig. 30.—Top Stave or Rung

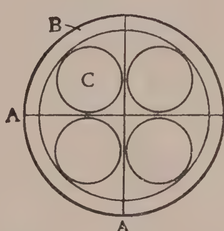


Fig. 24.—Section of Pole for Cleaving Four Staves

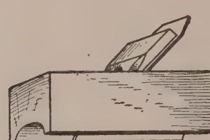


Fig. 25.—Plane for Rounding Staves

Fig. 26.—Stop for Use in Rounding Staves

Fig. 28.—Part of Ladder Put Together

Fig. 32—Part of Side showing Stave Wedged

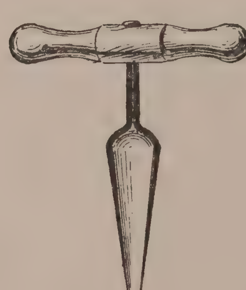


Fig. 31.—Bung-borer

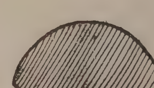


Fig. 33.—Section of Ladder Side when Finished

Fig. 27.—Sides of Ladder Set Out for Boring

Fig. 33. The ends of the sides can also be cut off at both top and bottom, leaving them 9 in. from the centre of the top and bottom stave respectively. Three iron bolts must now be inserted as in Fig. 28, one under the next stave but one from the top and bottom, and one halfway between. Quarter-inch bolts are stout enough, and the nuts should be let into the sides so as not to catch the hand when the ladder is in use. The three bolts mentioned are for a 20-ft. ladder. Short ladders would only require two, and longer ones four or five, or even six ; but there should always be one just under the two staves next to the top and bottom, the others being placed between at equal distances, but always close under a stave.

If the ladder is winding or twisting it must be cramped down at each end so as to twist it forcibly the opposite way from that in which it twists itself, and after it has been left in this position for a night it will most likely be found all right in the morning. All that now remains is to paint the ladder, and this is what is too often neglected, thus causing a great many ladder accidents. It should have at least three coats of good lead paint, any other is useless. The usual way is to paint the staves about 2 in. from the side, finishing them neatly.

STRONG ADJUSTABLE LADDER

The ladder illustrated by Fig. 34 is one that can be conveniently taken apart and hung on the wall.

The timbers are slightly larger than the ladders used for window-cleaning purposes. The sides are made of the best-quality yellow deal, and are finished 3 in. wide and $1\frac{3}{8}$ in. thick. The staves are of English oak, and are planed up to $1\frac{1}{4}$ in. wide and $1\frac{1}{8}$ in. thick. The lower and wider ladder is about 16 ft. long, and the narrower one about 14 ft. The width inside the lower ladder is $12\frac{1}{4}$ in., and the width outside the upper ladder is 12 in. Both ladders are parallel, and can be used separately when desired.

Advantage is taken in the variation of the strength of yellow deal when placed in tension or compression. The upper or outer side of the ladder, when in use, being in compression and the underside in tension, the staves are mortised nearer the front or outer edge of the side pieces to give the maximum of strength to the ladder. Yellow deal is weaker in tension than compression, so this method of placing the staves out of the centre gives a larger portion to the underside which is in tension, and a smaller portion to the upper side in compression. As the upper ladder slides behind the lower ladder, this method of fixing the staves allows the ladders to fit more closely together, so bringing the staves more into line at the junction of the ladder than if arranged otherwise (*see* Fig: 34).

In setting out the mortises, any cast or sag that should be in the timbers should be allowed for, and arranged in pairs, with the convex edges uppermost ; this will give the ladder a tendency to straighten when in use. Square pencil lines across the sides for the staves $1\frac{1}{4}$ in. apart, and arrange them so that the top of one stave is 11 in. from the top of the next. Then square these lines down both sides of the timbers, as in Fig. 35. The lines squared across on the outside for the wedges are a full $\frac{1}{8}$ in. away from the mortise lines. The mortise gauge should be set to the $\frac{3}{8}$-in. mortise chisel to be used, and the lines gauged so that the whole width of the mortise is above the centre line and $\frac{1}{8}$ in. away from it as shown. Mortise on the outer sides first, so as to give a better clearance for the waste when finishing from the inside. Then gauge for the $\frac{3}{8}$-in. haunch, and cut $\frac{3}{8}$ in. deep with a chisel. Fig. 36 shows the advantage of this kind of joint. The weakest part of a mortise-and-tenon joint is at the shoulder of the tenon. By making a double shoulder or haunch, this part is doubly strengthened. The tenon is reduced to the minimum thickness of $\frac{3}{8}$ in. ; thereby the sides are strengthened by cutting away the minimum amount of material, and that, in the part of the timber in compression.

The staves for the larger ladder should be 15 in. long, and those for the smaller

ladder 12 in. Make them $\frac{1}{4}$ in. longer at each end to allow for wedging and finishing off. Mark and cut the tenons, as shown, in the usual way. Plane off all sharp corners, and cut the wedges of oak about $1\frac{1}{2}$ in. long in readiness for framing together. The ends of the tenons should be trimmed with a chisel. Glue well and drive in the staves and wedge one by one, testing each side of the stave with a try-square whilst wedging.

Fig. 37 shows the best method of fixing on the second side of the ladder. Proceed by entering the tenons one by one until all the tenons grip. Then quickly glue all the tenons, and cramp the side up to its shoulders. A good cramp should be used in preference to a hammer. Then glue and drive in all the wedges. Saw off waste ends, and finish with a smoothing plane.

The patterns for the irons should be accurately drawn on a board for the blacksmith. The two irons shown by Fig. 38 are made of $1\frac{1}{2}$-in. by $\frac{1}{4}$-in. material, and are fixed about 3 in. from the top of the lower ladder. The four irons shown by Fig. 39 are of $1\frac{1}{4}$-in. by $\frac{1}{4}$-in. material, and screwed securely on the front of the upper ladder. Each pair of irons is fixed on level with the first and third staves of the bottom end, as shown in Fig. 40. These irons should be fixed to grip the staves of the lower ladder, so as to make the double staves even to tread on. It is convenient to enter the upper ladder into the iron bands from the top end, and slide upwards to the height required.

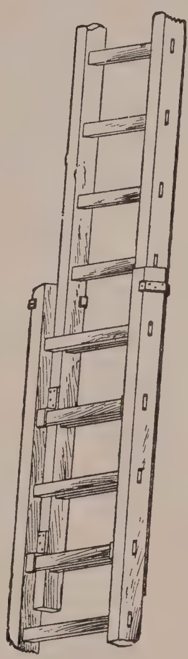


Fig. 34.—Perspective View of Adjustable Ladder

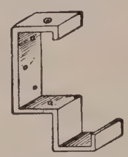


Fig. 38.—Iron Bands for Top Ladder

Fig. 39.—Shouldered Irons

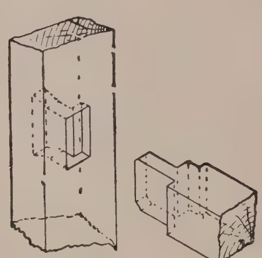


Fig. 36.—Haunched Mortise-and-tenon Joint

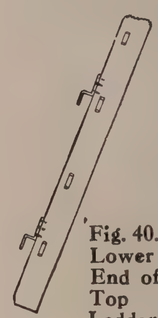


Fig. 40.—Lower End of Top Ladder

Fig. 35.—Setting out Sides

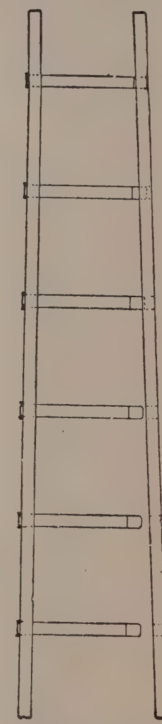


Fig. 37.—Fixing Second Side of Ladder

Sheds and Outdoor Erections

SMALL PORTABLE CYCLE SHED

THE portable cycle shed here il ustrated is designed to accommodate one, although it can be easily arranged to extend the size, so that i would allow of another being placed alongside.

In Figs. 1 and 2 are shown elevations of the framing at he front and back, whilst Fig. 3 is a plan of he floor and framing, also showing in the broken section a view of the framed joists carrying same and forming the groundwork on which the floor and sides are supported clear of the ground. The framing shown is intended to be covered with stout rot-proof canvas or thin "Ruberoid" or "Congo" roofing felt, otherwise with stout plain canvas which must be well painted. The framing also allows of using, instead of these materials, the ordinary fireproof board or thin planed matchboarding, say $\frac{3}{8}$ in. or $\frac{1}{2}$ in. thick.

The sides are framed up for the purpose of securing together, and forming complete parts in themselves. This is sometimes a great consideration when moving about the country. The base is dovetailed at the corners (*see* Fig. 5), and the intermediate bearers are stub-tenoned into the front and back pieces. It should be framed and pinned together truly square, and then the floorboards can be neatly nailed down, keeping back from the edges just the thickness of the framing and boring at the ends to prevent the nails from splitting and spoiling the job.

Tongued-and-grooved red deal boards are the best, in fact, all the stuff, excepting the top, should be red deal sound and dry. The framing stuff is prepared from 1-in. material. It should be mortised and tenoned together, keeping the thickness of the tenon one-third of the whole thickness, or say $\frac{5}{16}$ in. thick tenons all round (*see* Figs. 6, 7, 8, and 9). The braces are cut into the middle rail (*see* Fig. 8), and well screwed. The other end stub-tenons into top and bottom rails and stiles as shown. The intermediate or middle rails of the side and back framing, besides stiffening the frame, serve the purpose of keeping the wheels and handles off the canvas, which will then only be liable to injury from the outside.

The isometric details at the top and bottom (Figs. 4 and 5) show how the side framing forms the hanging part for the doors in front (*see* Fig. 11), using **T** or cross-garnet hinges on the top and bottom rails. The sides at the top are mortised to receive the sub-tenons of the cross-rail (*see* Fig. 10) which runs through. It could be preferably got out of $1\frac{1}{2}$-in. stuff and then rebated to receive the doors, although shown as 1 in. thick with a nailed or screwed fillet to form the stop. The roof board, being all in one piece of sequoia, whitewood, or a well-seasoned ash or elm board, lays on the sides and rests on intermediate bearers carried at the back and front, to which it is screwed from the

inside. It should hang well over all round to keep off the rain, and either be well-painted, creosoted, or covered with a roofing material. The cross bearers are half-boxed into the front and back framing, and have angle irons well screwed on to tie them across the top (*see* Fig. 12).

If canvas is used the edges should fold all round the framing edges and be tacked inside, care being taken to plane off the sharp edges so as not to cut the canvas. If any other flexible material is used, the writer would recommend 2-in. copper nails for the floor and brass screws for the other parts.

The base should be thoroughly creosoted and lightly fixed to creosoted sleepers buried in the ground, keeping the bottom just clear for through-ventilation purposes. Inside the shed there will be found ample room for a neat shelf or two to carry the accessories or cleaning appliances. The whole should be kept well painted with pleasing colours, and placed in a con-

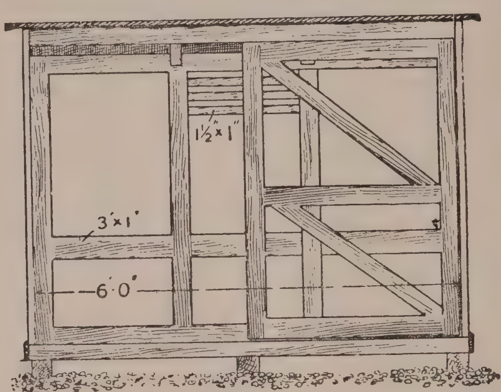


Fig. 1.

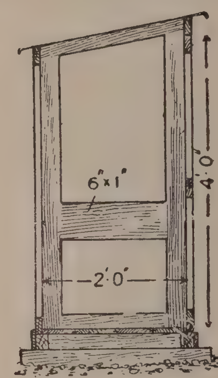


Fig. 2.

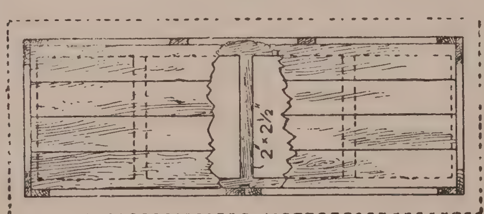


Fig. 3.

Figs. 1, 2 and 3.—Front and Side Elevations and Plan of Framework of Portable Cycle Shed

edges should be protected with fillets. Fillets or stops are nailed up the sides, along the top and on the door edges to form a tight joint. The usual fastening can be a couple of bolts and a padlock. The sides and back are neatly screwed at the corners when erecting same on the baseboard framing. The joint at the bottom is covered with a plinth or skirting well bevelled on the top edge and snugly fitting to the framing to exclude the wet. To make a satisfactory job the venient position. The drawings are to scale, the internal dimensions being 6 ft. long by 4 ft. high and 2 ft. deep back to front.

CHEAP CYCLE SHED

The illustrations (Figs. 13 to 16) give a plan, two sections, and an elevation of a small shed that will hold four cycles, using the junction made by two walls. Cycles require to be stored in as dry a

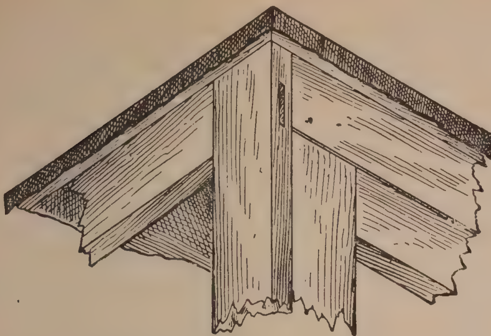


Fig. 4.—Front Top Corner of Portable Cycle Shed

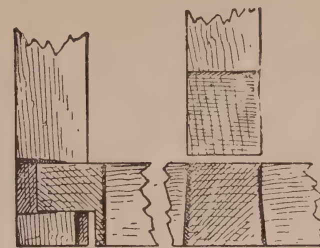


Fig. 6.

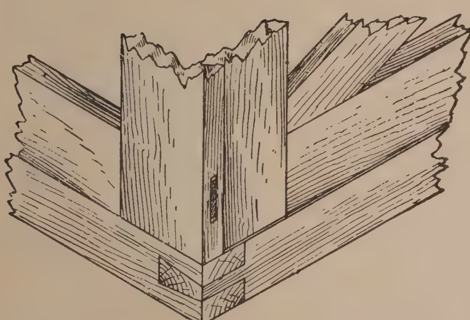


Fig. 5.—Front Bottom Corner of Portable Cycle Shed

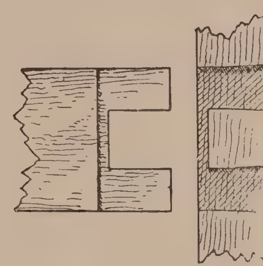


Fig. 7.

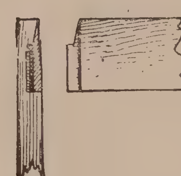


Fig. 10.

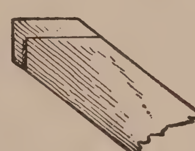


Fig. 9.

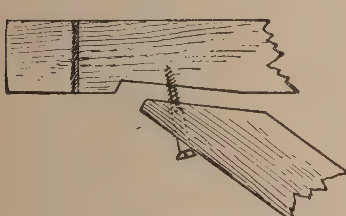


Fig. 8.

Figs. 6, 7, 8, 9 and 10.—Details of Joints of Cycle-shed Framing

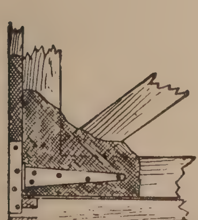


Fig. 11.—Corner showing T-Hinge Joint

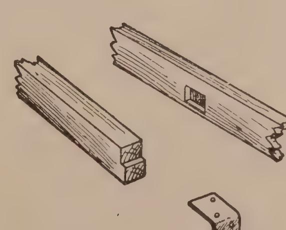


Fig. 12.—Detail of Cross Bearer and Joint with Angle-iron

place as possible, to avoid trouble and expense by rusting and frequent cleaning. This essentially means special precautions for keeping out wet and the prevention of dampness rising from the earth. Each cycle requires a width of 1 ft. 3 in. to 1 ft. 6 in., according to the the shed should be formed wheel racks of small scantling timber, placed in pairs diagonally, and at a distance apart sufficient to allow for the front wheel of the cycle to enter.

The following particulars should give a clear indication as to construction. A

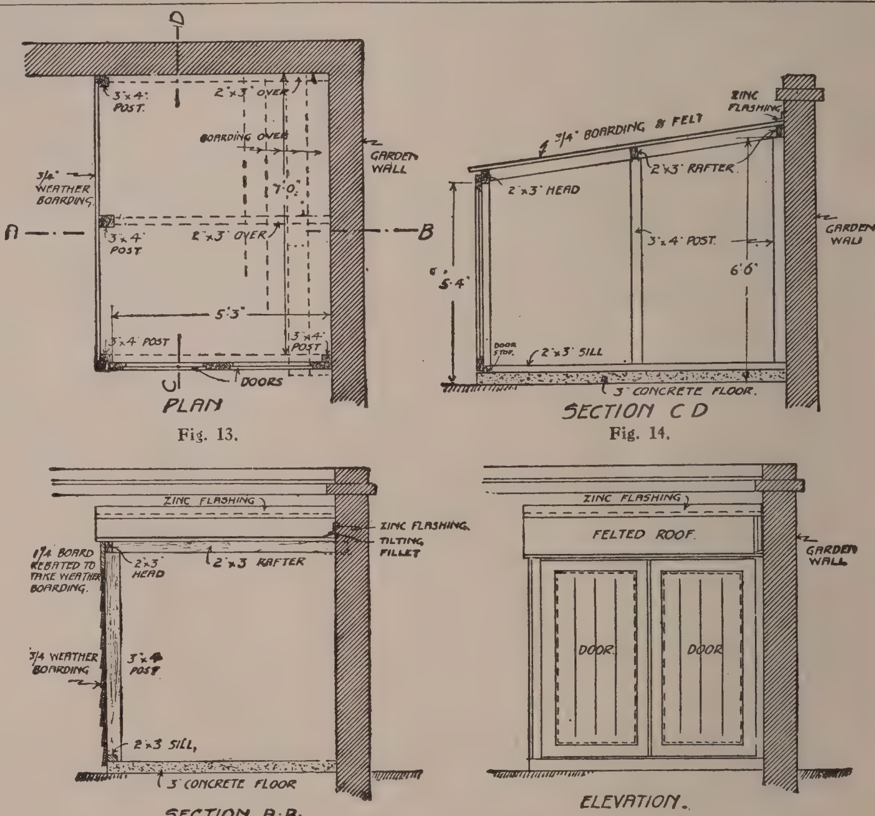


Fig. 13. Fig. 14. Fig. 15. Fig. 16.

Figs. 13, 14, 15 and 16.—Plan, Vertical Section, Cross Section and Front Elevation of Cheap Cycle Shed

width of the handle bars, if each is stored on a flat floor. If every alternative cycle is raised about 9 in. above its neighbour, then a much lesser width is required. Each cycle is about 6 ft. 6 in. long, and a length of 7 ft. should be allowed. The sizes shown on the illustrations will be sufficient to accommodate four cycles if raising blocks are used. At the rear of boarded floor, laid on wood joists, is not good unless a layer of concrete is laid over the site to prevent dampness. A cheap method of construction is to lay a 3-in. thickness of good concrete over the site, and to render the top of same. The concrete to be composed of one part of portland cement to four parts of fine aggregate, such as broken brick and sand.

The rendering to the top of the concrete to form the floor should be $\frac{1}{2}$ in. thick, and composed of one part of cement to three parts of sand. The sizes of sills, posts, heads and rafters are shown, and a careful adherence to the methods of framing will result in a very economical form of construction with dead bearings for nearly all members.

The side may be weather-boarded as shown, or by adding a rail between the head and the sill, it may be vertically matchboarded with $\frac{5}{8}$-in. or $\frac{3}{4}$-in. matching, which will require painting ; this will be unnecessary in the case of weather-boarding. The roof may also be weather-boarded ; but the slope will have to be steeper than shown. A better method is to use $\frac{3}{4}$-in. boarding, covered with bituminous felt. The water-tighting of the joint between the roof and wall requires careful attention to avoid constant trouble. A zinc flashing is the only practical method, and will be cheapest in the end. A cement fillet is not good. A small tilting fillet is necessary, as shown, to prevent water gravitating under the flashing.

The doors should be formed of stiles not less than $1\frac{1}{2}$-in. by 4-in. (nominal thickness), and top and bottom rails, with $\frac{3}{4}$-in. matching rebated into the framing as shown. The hanging stiles fit into the rebated posts ; the top rails abut against the 2-in. by 3-in. head ; and the bottom rails against small stops at the floor level. The quantities of timber required will be : 26 ft. run of 2-in. by 3-in. ; 23 ft. run of 3-in. by 4-in. fir for the framing ; 32 ft. run of $1\frac{1}{2}$-in. by 4-in. (out of 3-in. by 4-in.) for the doors ; 8 ft. run of 2-in. by 3-in. triangular tilting fillet (out of 2-in. by 3-in.) $\frac{1}{2}$ square of $\frac{3}{4}$-in. average thickness weather-boarding ; $\frac{1}{2}$ square of $\frac{3}{4}$-in. grooved-and-tongued matching ; $\frac{1}{2}$ square of bituminous felt ; $4\frac{1}{2}$ yd. super of 3-in. concrete floor with rendering ; $4\frac{1}{2}$ yd. levelling ground.

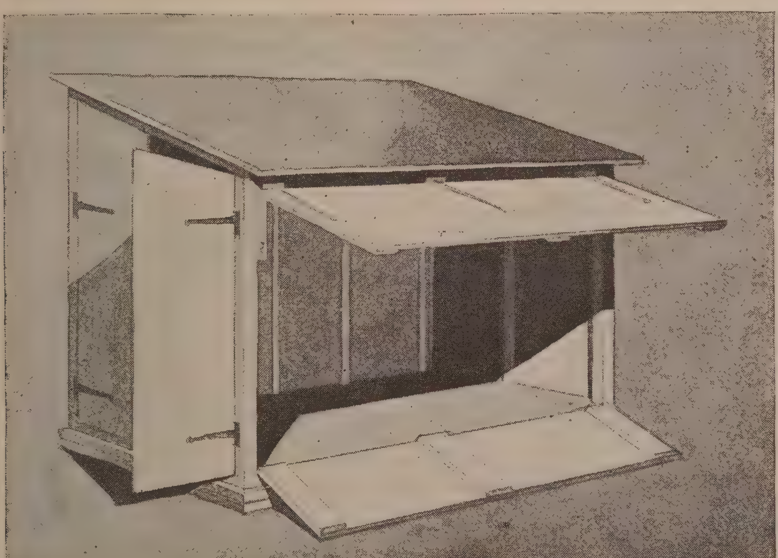


Fig. 17.—Motor-cycle and Side-car Shed

SHED FOR MOTOR-CYCLE AND SIDE-CAR

The motor-cycle and side-car shed shown above has folding-doors at one end, (Fig. 17), although a single door would suit in the case of a narrower erection, and it has a small window in the centre of

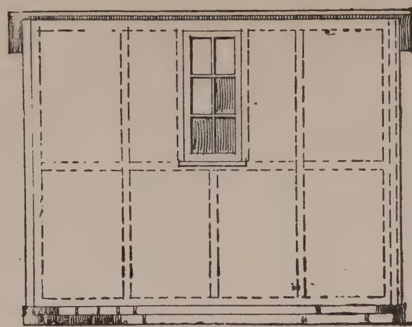


Fig. 18.

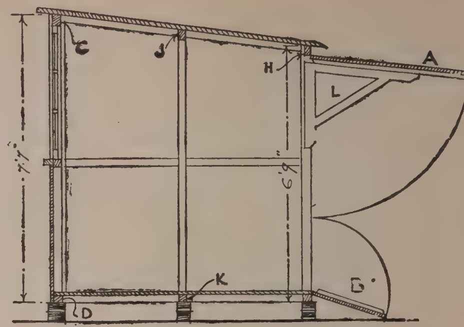


Fig. 19.

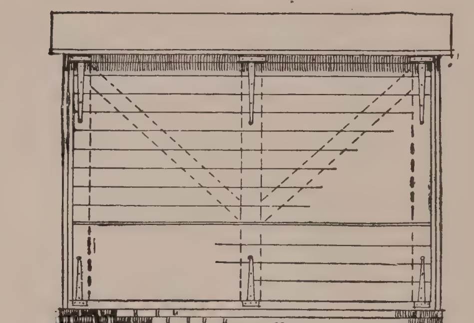


Fig. 20

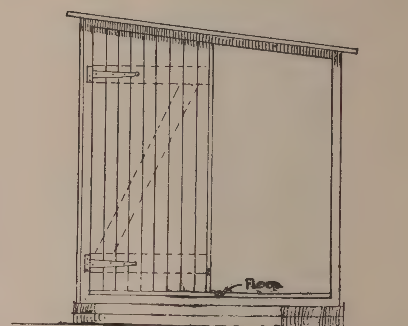
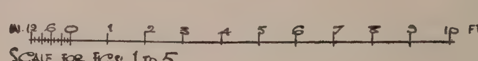


Fig. 21.



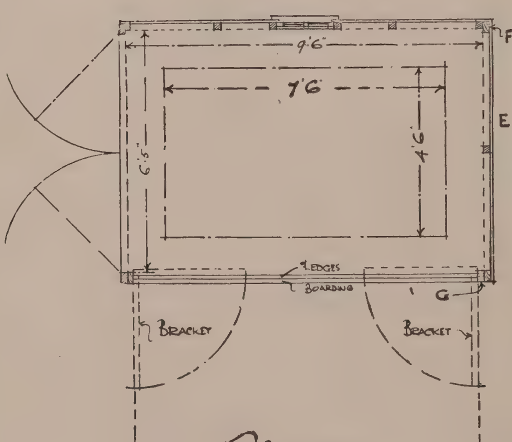


Fig. 22.

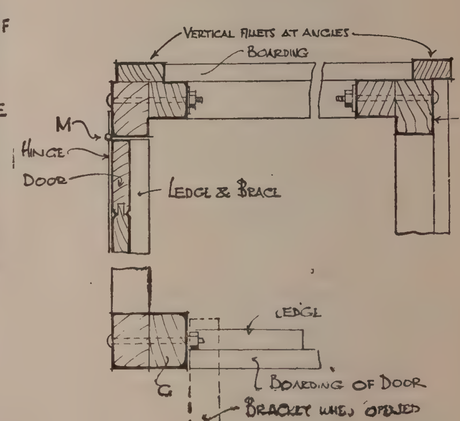


Fig. 23.

Figs. 18, 19 and 20.—Front Elevation, Cross-section and Back Elevation of Motor-cycle and Side-car Shed

Figs. 21, 22 and 23.—End Elevation, Plan and Detailed Plan of Framing of Motor-cycle and Side-car Shed

the back which could be omitted if not thought necessary. The front is in two portions, one hinged to lift upwards and form a shelter, as at A in Fig. 19, and the other falling as at B to form a convenient slope from the floor to the ground. A somewhat smaller shed would suffice for motor-cycles without side-cars, and other purposes ; but working to the sizes given would result in a shed large enough to allow at least 12-in. margin round any cycle and side-car.

Each side is constructed as a separate section, thus simplifying the work and permitting an easy taking to pieces for removal, the whole being fixed together with $\frac{3}{8}$-in. bolts. The back is framed as dotted in Fig. 18, with 2-in. by 2-in. uprights and middle rail; a 3-in. by 2-in. head C (Fig. 19) fixed upright and splayed to suit the slope of the roof, and a 3-in. by 2-in. sill D (Fig. 19) laid flat. The fixed light shown can easily be inserted if desired. The end at E (Fig. 22) has a 2-in. by 2-in. centre upright a middle rail and head (raking to suit roof), a 3-in. by 2-in. sill as before, and 3-in. by 2-in. angle-posts, as at F in Figs. 22 and 23. The front has a 3-in. by 2-in. sill and uprights G (Figs. 22 and 23) and a 5-in. by 2-in. splayed head H (Fig. 19).

When the framework has been bolted together and set on a base of bricks or sleepers clear of the ground, a longitudinal bearer, as at J (Fig. 19), about 3 in. by 2 in., can easily be fixed to take the roof boarding, which should be felted, tarred and sanded. A similar central bearer, as at K (Fig. 19) serves to take the floor ; but as it can be supported at close intervals it need only be 2 in. deep. The ends of the boards will rest on the sill as shown, and if desired they could be put together in sections by means of ledges on the underside.

The back and fixed end can be covered with vertical tongued-and-grooved boards, or horizontal feather-edged boarding, either of which will stiffen the work considerably. Horizontal boarding will look best if stopped against vertical fillets at the angles, as shown at the top corners of Fig. 23. The entrance end is filled in with doors of boarding ledged and braced, as dotted in Fig. 21. The front is filled in with boarding, as in Fig. 20, with ledges at the extreme ends and centre, and braces in addition on the upper portion. This latter is hinged, as in Fig. 19, with cross-garnets and supported when open by means of two framed brackets as at L. The pins of the hinges for these should be arranged at the point marked M in Fig. 23, so that when closed the brackets are clear of the closed front, and when open, as dotted in the same figure, they come under the end ledges previously mentioned. Shorter hinges will suffice for the lower flap of the front.

TOOL SHED OR GARDEN SHELTER

A tool shed and shelter, the making of which will neither be very costly nor tax the skill of the average handyman, is shown in Fig. 24. The shed is constructed in sections consisting of a front, two sides, a back, and a roof, which are made separately and screwed together. A seat is fitted to the interior of the shed. The framework could be of deal, covered with grooved-and-tongued matchboarding The sizes to which the shed should be made are shown in the illustrations. It will not be advisable to interfere with the height of the shed, but, if desired, it could be made either larger or smaller on plan. The dimensions 3 ft. wide by 3 ft. 6 in. deep will give a shed of very useful size ; but for those who require a smaller shed these dimensions could be reduced to 2 ft. 6 in. by 3 ft., and this will, of course, result in a saving of material.

The front framework of the shed, which is shown by Fig. 26, consists of two side rails 6 ft. 6 in. long by 3 in. wide by 1 in. thick, top rail 3 ft. long by 3 in. deep by 1 in. thick, and a bottom rail 2 ft. $8\frac{1}{2}$ in. long by 2 in. deep by 1 in. thick. The top and side rails are half-lapped and screwed together, as shown by Fig. 31, and the bottom rail is screwed to the inside of the side rails, as shown by Fig. 32, a space of $1\frac{3}{4}$ in. being allowed between the ends of the bottom rail and the outer

edges of the side rails for the thickness of the sides of the shed.

The framework of the sides, which is shown by Fig. 27, consists of a front rail 6 ft. 6 in. long, back rail 5 ft. 9 in. long, and top, middle, and bottom rails, which are 3 ft. 6 in. long by 2 in. wide by 1 in. thick. The framework is half-lapped and screwed together, as shown by Fig. 31. Struts, which should be of a similar section to the framework, are fitted from the front bottom corner to the back of the middle

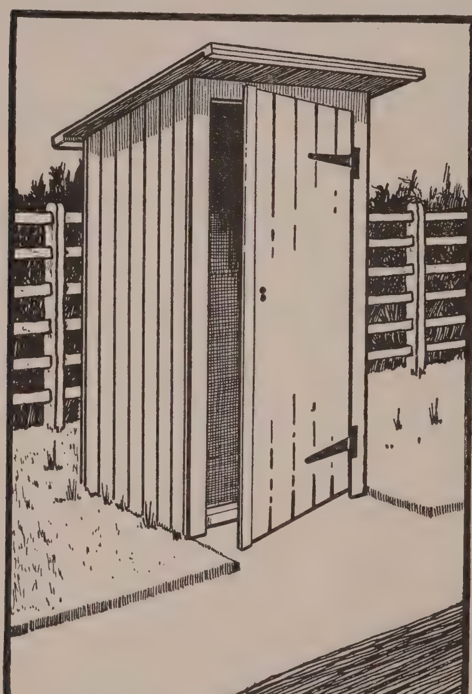


Fig. 24.—Tool Shed or Garden Shelter

rail, and from this point to the front top corner. The sides are covered on the outside with $\frac{3}{4}$-in. matchboarding. The back is made to the dimensions shown in Fig. 28, being formed with $\frac{3}{4}$-in. matchboarding. which is held together at the top with a batten 2 ft. $8\frac{1}{2}$ in. long by 3 in. deep by 1 in. thick; and at the bottom with a batten 2 ft. $8\frac{1}{2}$ in. long by 2 in. deep by 1 in. thick. Struts which are 2 in. wide by 1 in. thick should be fixed across diagonally between the battens, as shown in Fig. 28.

The front, sides, and back are fixed together, as shown by Figs. 30 and 33. The sides fit between the front and back, and screws are driven through the front and back into the sides. A floor could be provided, being formed of 1-in. boards, which rest on the top edges of the bottom members of the framework, and are supported in the middle with a bearer, as shown by the dotted lines in Fig. 30. A seat should be fitted across the back of the house, as shown in Fig. 25, and should be about 1 ft. 6 in. wide, formed with 1-in. boards resting on cleats fixed to the sides of the shed. The seat should be about 1 ft. 6 in. high, and should be slightly higher at the front than at the back. The roof could be formed with $\frac{3}{4}$-in. or 1-in. grooved-and-tongued boards, which run from the front to the back of the shed and are held together with two cross battens, as shown by Fig. 34. It should overhang about 3 in. at the sides and back, and about 8 in. at the front, while it is either screwed or nailed to the top edges of the front, sides, and back. The roof should be covered with roofing felt or a piece of canvas, the wood being well painted before the material is fixed.

The door of the shed is made up of $\frac{3}{4}$-in. matchboarding, as shown by Fig. 29, being held together by two cross battens about 6 in. by 1 in. in section, and a diagonal batten about 3 in. by 1 in. in section. The door is hung on the right-hand side with a pair of long-flap **T**-hinges, as shown in Fig. 24, and it should also be provided with a lock and key. A small fillet should be fitted to the shutting edge of the door, as shown in Fig. 35. Ordinary boards of almost any width could be used for covering the shed, if desired, instead of the matchboards; but it will be well in that case to cover the joints with fillets, as shown in Fig. 36. The shed when complete should rest on a row of bricks to protect the base from wet rot.

Needless to say, the work should be finished with two or three coats of good oil paint; a coat of varnish over the paint will help to repel the weather.

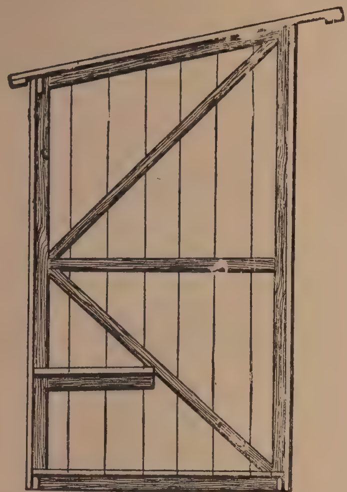


Fig. 25.—Sectional Elevation of Tool Shed

Fig. 26.—Front Framework

Fig. 27.—Side Elevation of Tool Shed

Fig. 28.—Back of Tool Shed

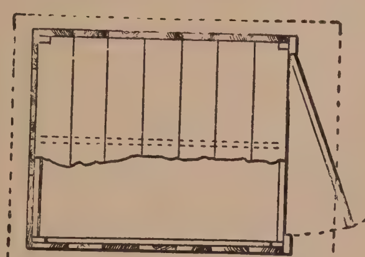


Fig. 30.—Plan of Tool Shed

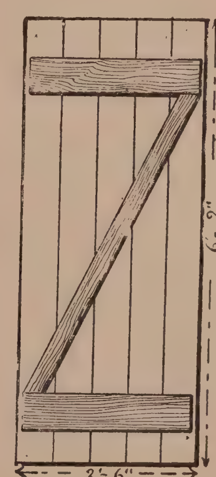


Fig. 29.—Door

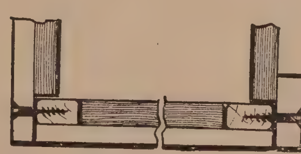


Fig. 33.—Method of Fixing Sides, Front and Back

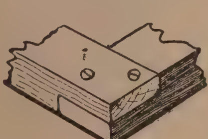


Fig. 31.

Figs. 31 and 32.—Framework Joints

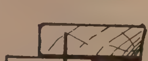


Fig. 35.—Fillet Fixed to Edge of Door

Fig. 36.—Method of Covering Joint

Fig. 32.

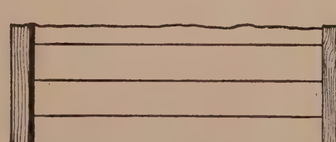


Fig. 34.—Part Plan of Roof

SANATORIUM FOR OPEN-AIR TREATMENT

A sanatorium for open-air treatment is here described and illustrated in such a manner as to render the construction of a similar one a matter of plain straightforward carpentry.

In size the structure measures 6 ft. long by 4 ft. deep on the inside, the height

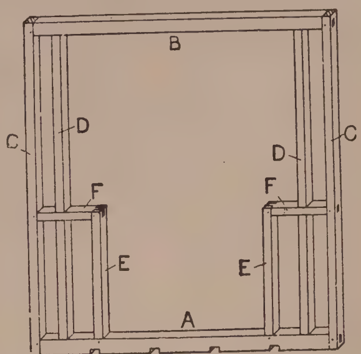


Fig. 37.—Front Frame of Sanatorium

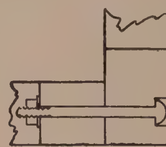


Fig. 47.—Bolting Framework

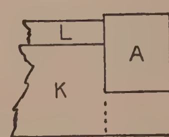


Fig. 48.—Fitting Joist to Rail

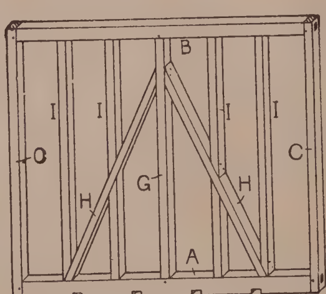


Fig. 38.—Back Frame of Sanatorium

Fig. 43.

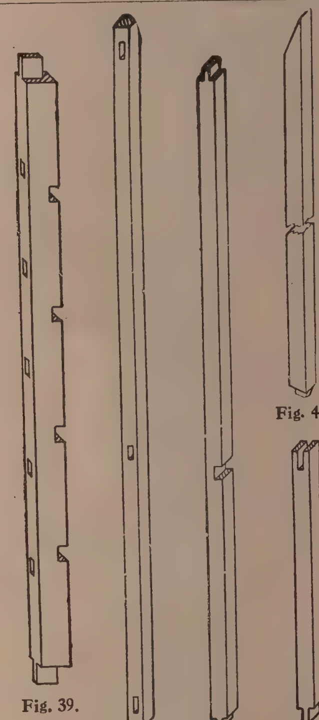


Fig. 39. Fig. 40. Fig. 41. Fig. 42. Fig. 44.

Figs. 39 to 44.—Details of Frame Members

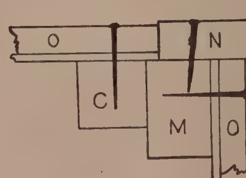


Fig. 49.—Section of Corner

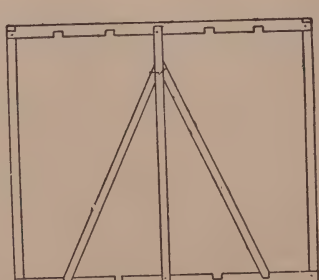


Fig. 45.—Skeleton of Back Frame of Sanatorium

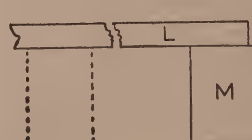


Fig. 50.—Section of Floor

Fig. 46.—End Frame of Sanatorium

being 6 ft. 10 in. at the front and 5 ft. 4 in. at the back, also on the inside. It may be stated that it will be better to make the structure larger than this rather than

Fig. 51.—Framing of Building without Joists

smaller, the appearance when finished being quite different than when the various parts are being put together. A width of five feet would perhaps be better than four feet.

As shown by the photographs, the front is practically entirely open, the ends and sides being closed in and made as nearly draught-proof as possible. The whole structure revolves on a platform so that the patient can have the sun or not, as he pleases, and can turn his back to the cold winds at will. The outside is weather-boarded with feather-edged boards, and the inside is lined with three-ply wood, thus making it practically airtight. The roof is formed with tongued-and-grooved boards, also lined with three-ply and covered outside with Ruberoid felt. The floor is of tongued-and-grooved boards and should be covered with linoleum.

The actual construction of the building will now be dealt with. For convenience of removal at any time it is made in sections, and can be unshipped in two or three hours. As being the most complicated, begin with the front section, as shown by Fig. 37. This consists of the bottom rail A (4 in. by 2 in.), the top rail B (3 in. by 2 in.), the outside uprights C, the long and short intermediate uprights D and E, and the intermediate rails F, all of these latter being 2 in. square. The back section is as shown by Fig. 38, and consists of the bottom rail A, similar to that on the front section, the top rail B, to which the same applies, and also to the outside uprights C. After this, however, the similarity ends, the middle upright G, the braces H, and the filling-in studs I, are all 2 in. square, as in the front section. The framing of these two sections can be dealt with at the same time, there being to a certain extent a likeness between them.

The whole construction is, of course, based on mortise-and-tenon joints, and in Fig. 39 is shown the bottom rail of the back section (Fig. 38) tenoned to fit the outside uprights, and mortised to take the braces and the upright studs; also slotted on the underside to fit the floor joists, of which more later on. In fact,

Fig. 52.—Building Turned Up to Cut Slots for Joists, Two Slots Cut, One Joist in Position

it will be as well to leave this out at present and cut them after the sections are fixed together. The bottom rail of the front section must be done in exactly the same

way as Fig. 39, except as regards the mortises for the studs, which must, of course, be made to suit the positions of the long and short intermediate uprights.

In describing the back section the two rails and the two outside uprights are the ones that have, so far, been mentioned. The middle upright, which is the only one needed the full length, must be tenoned at each end to fit into the top and bottom rails, the length from shoulder to shoulder being the same as the distance between the mortises in the uprights. This section

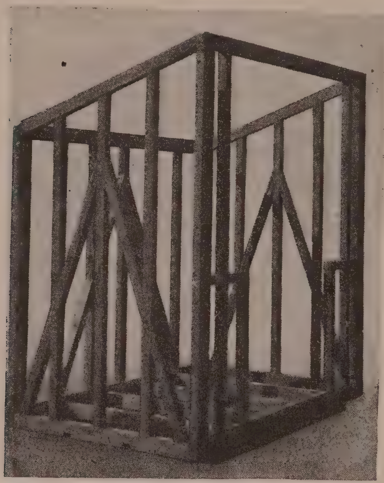


Fig. 53.—Building Framed with Joists in Position

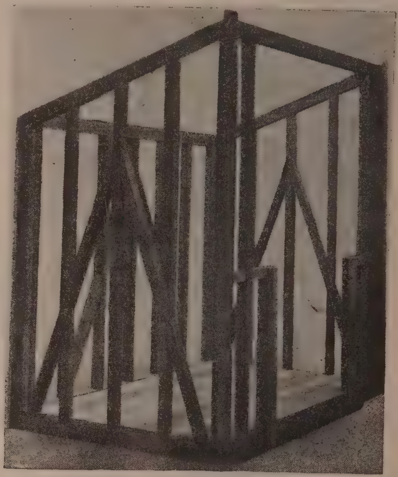


Fig. 54.—Stops for Weather-board Fixed and Floor Laid

The outside upright is shown by Fig. 40, mortised to take the top and bottom rails, and also the intermediate rail. The four uprights (for the front and back sections) will be exactly alike, except that those for the back section will not require the middle mortise, there being no intermediate rail.

Fig. 41 shows the intermediate upright D, tenoned to fit into the top and bottom rails, and halved to fit the short intermediate rail. Fig. 42 shows the short intermediate upright E tenoned to fit into the bottom rail and slot-mortised to take the short rail, while Fig. 43 shows the latter tenoned to fit the outside upright and the short upright E, and halved to fit to the intermediate upright D. As regards the front section, the various parts will be fixed together with wood pins, the joints either pulled up tightly with cramps, or, what is better, each tenon can be draw-bored so that the driving in of the pin will pull the joint up tightly. The halving joint connecting D and F is best fastened together with a screw inserted from what will be the inside of the building.

Fig. 55.—Building Weather-boarded, but without Roof

can now be put together with the five parts which are ready, after which the two braces can be tenoned to fit in the two mortises nearest the outside uprights, cutting the shoulders to the angle required, which, as well as the correct length and angle of the upper end, can be obtained by laying one of them in position and marking by the parts to which they have to fit. The brace, tenoned and cut to the required angle, is shown by Fig. 44, and the other one should be cut to the same length and angles, but the opposite way so that they form a pair.

On fixing the two braces, as shown in Fig. 45, the fact of bringing the upper ends on the same level against the middle upright will ensure the frame being square. The remaining four uprights in the back section will simply require tenoning at one end and cutting to the length and angle to fit the braces, to which they will be fixed by nailing. The bottom end will require no further fixing beyond insertion into the mortises in the rails.

The back and front sections are now finished for the time being, and attention can next be given to the ends, one of which is shown by Fig. 46. These are framed and fixed together in precisely the

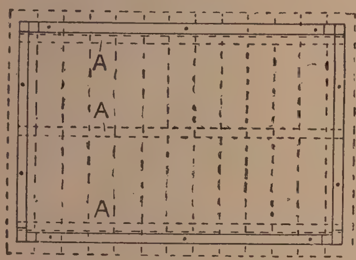


Fig. 56.—Method of Forming and Fixing Roof

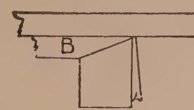


Fig. 57.—Detail showing Roof Ledge in Position

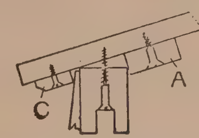


Fig. 58.—Fixing of Roof

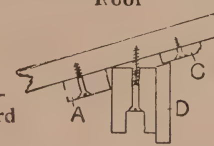


Fig. 59.—Face Board

Fig. 60.—Front View of Building with Roof

Fig. 61.—Back View of Building with Roof

same way as the back, the angle and lengths of the top rail, uprights and braces, being found by laying the various pieces in position and marking. Remember that the outside uprights at the back and front must be the same length as the corresponding parts on the back and front sections, to which they have to finish level at both the top and the bottom. It will also be noticed that there will be no tenon on the bottom ends of the braces, these simply resting against the bottom rail, to which they are fixed with nails as at the upper end. The uprights at the outside of the end frames are 3 in. wide, and the top and bottom rails are the same width; the remaining parts are 2 in. only, and the whole of the parts are 2 in. thick.

The four sections can now be bolted together, using three bolts at each corner. The end sections will fit against the sides, the 3-in. wide upright on the former projecting beyond the narrower side upright, as in Fig. 47, the purpose of this projection being seen later on. The heads of the bolts must be sunk in as shown, and the two parts must be kept level while the holes for the bolts are made. If the slots for the floor joists have been left as mentioned before, the whole erection can now be turned on its side and these slots made. The joists should be cut to fit so that they will be as in Fig. 48, where K is the joist, cut so as to come level with the front (and back) bottom rail on the underside, and leaving a space for the floorboard L to fit against the rail as shown.

The joists will not require fixing to the rails in any way; in fact, they must not be fixed, but the rails must be simply allowed to rest on them. To make the structure firm for the time being, blocks should be so placed under the joists that these will all take equal weight, and no other part rest on anything but the joists, and while in this position the backs, two ends and the front can be weather-boarded. In order to give a finished appearance to the building, upright strips must be fixed at each corner and the boards fitted between. These strips must be fixed to the edge of the upright on the *ends* of the building, as in Fig. 49, where M is a part of the end frame with the upright "stop" N fixed to it, and C is the part of the front frame to which the "stop" must not be fixed; O is the weather-boarding. In like manner, in fixing the weather-boards they must be fixed only to the parts as shown, otherwise the sections will not come apart when required. Similar stops must be fixed at the openings in the front of the building, as shown in the photographs.

After finishing the weather-boarding the floor can be laid, but the boards must be fixed to the joists only. They will run over and rest on the bottom rails of the end framing. Fig. 50 shows a section of the floor at the end framing, the boards resting on the bottom rail, the dotted line being one of the joists. Photographs, showing the various stages of the construction so far described, are reproduced in Figs. 51 to 55 inclusive.

The next part to give attention to is the roof. This consists of 1-in. tongued-and-grooved boards held together by three ledges formed of strips of the same board. Fig. 56 shows in detail the method of forming and fixing the roof to the building. The solid lines represent the top rails of the front, back, and the two end frames; the dotted lines A represent the three ledges for holding the roof boards together; and the dotted lines at right angles to these are the boards forming the actual roof.

The ends of the ledges are cut off at a slope, as at B (Fig. 57), and the top rails of the end frames are cut away to suit, so that when the ledges are laid in position the upper surface will be level with the top rails. The roof boards are then laid on the ledges, and one by one screwed to them from the inside, one screw through each ledge into each board, allowing the first and the last boards to project over the ends of the building some $1\frac{1}{2}$ in., as shown in Figs. 56 and 57. This will fix the roof boards together; but at present they are not fixed to the building itself. To do this, screws are inserted from the inside through the top rails of the frames into the roof boards, as in Figs. 58 and

59, which show sections at the back and front respectively. Three screws should be used at the front and back, and two at each end, as shown in Fig. 56.

Fig. 63.—Platform on Stumps with Floor in Position

It will be found in fixing the roof boards together that the two outside boards are not very firmly fixed owing to the ledges not reaching the outside. To obviate this, strips as at C should be screwed to the underside of the boards at both top and bottom, as in Figs. 58 and 59. At the front also it is as well for the sake of appearance to fix the face piece D along the top rail, as in Fig. 59.

It can now be seen that to remove the roof intact, all that is needed is to withdraw the ten screws from the inside, and the whole is free. Front and back views of the complete building are shown in the photographs, Figs. 60 and 61. The frame for the platform on which the building will revolve is shown by Figs. 62 and 63. It is 3 ft. 10 in. square, and is built up from 3-in. by 2-in. deal, placed edgewise as shown; and as the construction is simple no description is necessary.

The platform frame must be covered with 1-in. tongued-and-grooved boards (Fig. 64), allowing them to project over it about 2 in. all round, and cutting off the corners, as in Fig. 64. This illustration also shows the metal rack as fixed, and as this is important that it be fixed to an exact circle, the method adopted to attain this must be described in detail. The section of the track is as E (Fig. 65), the ball-bearing runner working on it as at F; but at intervals of about 8 in. the base of the track is flattened out to the section G, and the flange thus formed is drilled for screws, this forming the means of fixing in position. It thus follows that the track must be bent to the circular form.

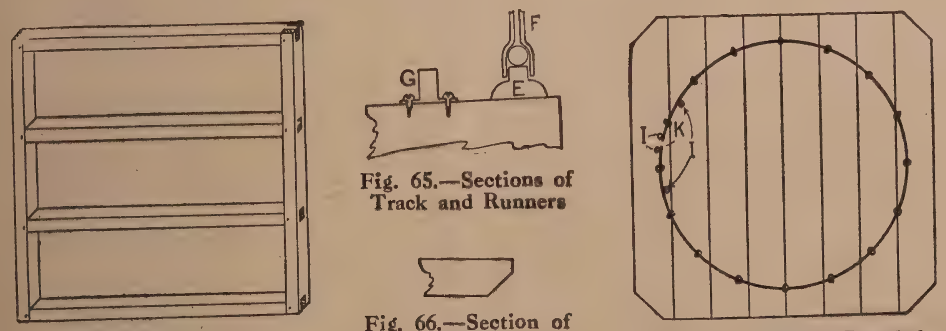


Fig. 62.—Frame for Platform

Fig. 65.—Sections of Track and Runners

Fig. 66.—Section of Wood Segment used in Finished Track

Fig. 64.—Platform Boarded and Track Fixed

The method adopted by the writer, and which was a perfect success, is as follows: A circle of the size of the inside of the track proper (not the base) is described on the platform, and a piece of board about 15 in. long is cut to the same radius, the under edge being bevelled off, as in Fig. 66. This segment is screwed to the platform with the circular edge coinciding with the circular mark, as at H

(Fig. 67), and the track placed in contact with the wood at one end and fixed. The track is then gradually bent round into contact with the wood and the other screws inserted, moving the wood to a fresh position as required until the circle is complete. It is obvious that only

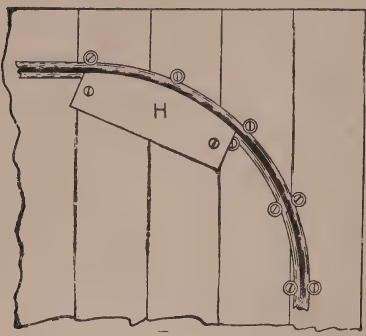


Fig. 67.—Detail showing Fixing of Track

the outer screws can be inserted to fix the track until the wood is removed to a fresh position. After this is done, however, the inner screws should be inserted at once in case the track is strong enough to have a tendency to draw out the outer screws.

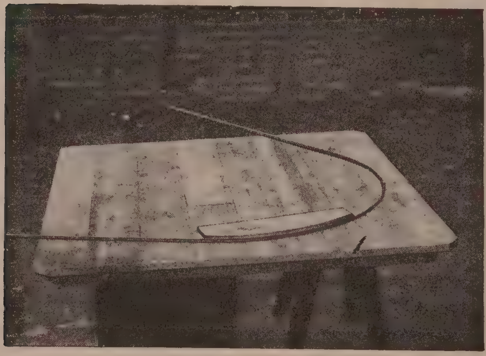


Fig. 69.—Platform showing Track being Fixed

The only difficulty encountered in the fixing of the track is where the ends of the track meet. Here the stiffness of the metal has the tendency to resist the bending to the circle; but this is overcome by inserting extra screws inside and outside the track as required. These screws, acting on the bevelled base, force the track in and out as wanted until the true circle is complete. These extra screws are shown at I (Fig. 64), the joint in the track being at K.

The platform with the track complete is fixed to four oak stumps planted firmly in the ground, projecting above the ground

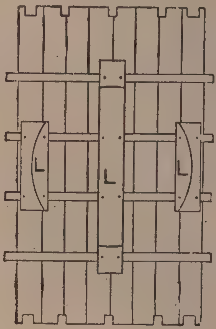


Fig. 68.—Detail showing Boards Fixed under Floor to which Runners are Fixed

to the height required, and finished perfectly level at the top, this being absolutely necessary if the building is to revolve easily when finished.

To prepare the underneath part of the floor for the ball-bearing runners, and to do this conveniently, the building should

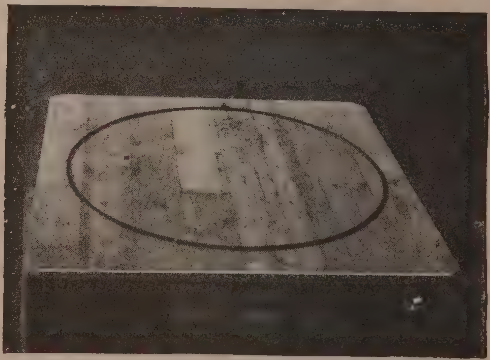


Fig. 70.—Platform, with Track Complete

be taken to pieces so that the floor can be turned up. This being done, the three pieces of board (not less than 1 in. in thickness) must be screwed to the joists as at L (Fig. 68). On these boards the circle must be struck as before, as shown, and this is the guide for the insertion of the runners, which will simply be let in

so that the flanges can be screwed to the boards. If the circle, as marked on the boards L, is made to the same radius as that on the platform to which the track is fixed, the inside face of the balls must be at the same distance when the pulleys are fixed. Some care is necessary here, or there may be friction through the flanges of the runners pressing against the inside or outside of the track; but if care is taken to get it right, the building will revolve quite easily. Fig. 69 is a photograph showing the actual fixing of the track, and Fig. 70 a photograph of the platform and track complete.

The lower part of the opening at the

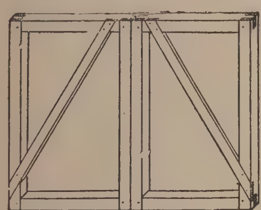


Fig. 71.—Framing of Doors

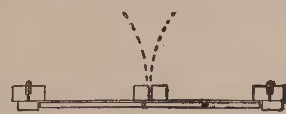


Fig. 72.—Sectional Plan of Doors

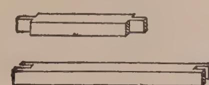


Fig. 73.—Rail and Upright of Doors

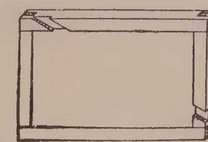


Fig. 74.—Frame of Door Slotted for Brace

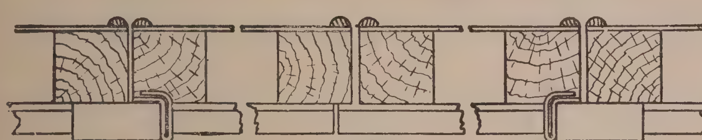


Fig. 75.—Sectional Plan of Doors

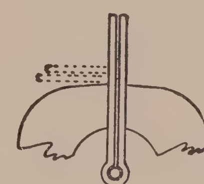


Fig. 76.—Method of Bending Hinges


Fig. 80.

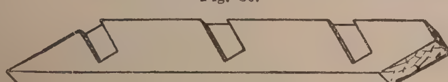


Fig. 81.

Figs. 80 and 81.—Right- and Left-hand Strings of Stairs


Fig. 77.—Vertical Section of Doors showing Top Board

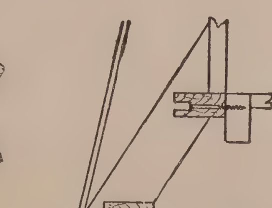
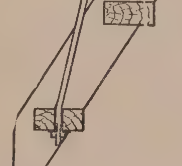



Fig. 79.—Sectional Elevation of Stairs


Fig. 83.—Fixing of Rods at Top

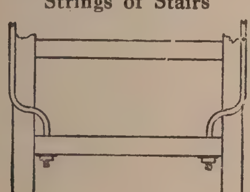


Fig. 82.—Elevation of Stairs showing Rods Cranked

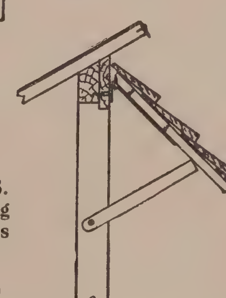


Fig. 84.—Showing Fixing of Awning


Fig. 78.—Plan of Top Board showing Cuts

front of the building is closed in with folding doors, the frames for which are shown by Fig. 71. They are covered with weather-boarding, that on one door overlapping that on the other, as in Fig. 72, thus forming the necessary rebate. The frames of the doors are put together with slot mortise-and-tenon joints. One of the rails with tenons cut, and one of the uprights with mortises made, are shown by Fig. 73.

In order to be certain that the doors will keep their shape it is best to fix a small brace as shown. This is simply a plain strip of wood, the door framing being cut away to take it, as in Fig. 74. To revert back to Fig. 72, it will be noticed that the door fits behind the stop on the framing of the building; but the boards fit between these stops, thus preserving the same line in the boarding throughout, and causing the boarding of the doors to form a part with, and to agree with, the rest of the building.

In the illustration the doors are shown as opening inwards, but as this takes up a certain amount of room, an alternative method of arranging them to open outwards is described.

This is shown in Fig. 75. The framing of the doors fits up to the framing of the building, and as the stops project forward beyond this, it follows that the knuckle of the hinge must come to the face of the stops, and fit between these and the ends of the weather-boards on the doors. Outside hinges would solve the difficulty easily, of course, but in a very clumsy manner, and back flaps adapted by bending them as shown, are preferable.

In order that the doors should open properly, it is necessary that all the hinges shall be bent alike, and also that the two parts of each hinge shall be bent at the same time, otherwise they would not fit easily and closely together. The hinges are bent as shown in Fig. 76; screwing each one tightly in the vice with the jaws at the line where the bend is to be, the upper part can be forced to the position shown by dotted lines by means of a heavy hammer. If this is done carefully, there is no risk of breakage, or of the hinges not being practically all alike when finished. In hingeing the doors, the hinges must be let into the wood as required, the best way being to let the full thickness into the doors, not cutting away the wood of the stop at all. Good hold for the screws will be found in both the edge and back of the stop, and in the framing of the doors and the ends of the weather-boards.

The boards of the right-hand door should overhang the frame about ½ in., thus forming the necessary rebate where the doors meet, and obviating the need for any stop being fixed on. Bolts on the inside, shooting into the floor, will be all that is wanted in the way of fastenings, as it is easy to reach over from the outside to either open or fasten them up. Along the top of the doors is fixed a plain board with the nosing worked on each edge, as shown in the section (Fig. 77). This board should be fixed to the doors and to the side openings in one piece, cutting it afterwards as required; that is, immediately over each hinge (where it will have to be notched, as shown in Fig. 78) and in the middle where the doors open. This latter cut must be on the slope as shown, to allow the right-hand door to open freely; if the cut is square the door will bind.

The building being on a fairly high platform requires a step or two to get to it comfortably. In the present case a flight of three steps is needed and provided, the upper step being on a level with, and forming a continuation of, the floor. These steps are made entirely of 4-in. by 2-in. deal, the treads being trenched into the strings, and fixed together with nails from the outside. The strings continue upwards, and are fixed to the stops at each side of the door opening; but as this would not be sufficient fixing, even with the assistance of the screws through the upper tread into the sill, make them perfectly safe by the use of two iron rods which pass through the lower tread, fixing with bolt and nut, and screwed firmly to the facia board at the top ends. These rods are cranked just above the stair tread, to allow the doors to open to the

full width of the opening. They also serve as very efficient handrails to the stairs, a necessary item in the case of an invalid.

The construction of the stairs is very simple, and should be perfectly plain to

Fig. 85.—Section of Window at Side

Fig. 86.—Section of Window at Bottom

Fig. 85.

Fig. 86.

anyone who will study the illustrations for a few minutes. Fig. 79 is a sectional elevation after the stairs are fixed, and Figs. 80 and 81 are the pair of strings with

Fig. 87.—Back of Finished Sanatorium

Fig. 88.—Front of Sanatorium, with Doors Closed

the trenches made to take the treads. The latter are not illustrated, as they are simply cut off square at the ends to the correct length, when they are ready for fixing. Fig. 82 is a front elevation of the stairs (bottom part only), and will make the cranking of the rods plain, while Fig. 83 shows the fixing of the rods at the upper end to the facia board.

The front awning is necessary to keep the wet from driving into the front, if for any reason it is not convenient to turn the building back to the weather for the time being; but it is more necessary to keep off the direct rays of the sun, when for any reason it has to be kept facing that way. The awning is made up of weather-boards (feather-edged) held together with three ledges, and is hinged at the top just under the roof, as in Fig. 84. It can thus be raised to a nearly horizontal position; or, if required, it can be allowed to fall to a vertical position; or it may be fixed at any point between by varying the adjusting rods, one of which is fixed on the inside of each lining at the extreme width of the opening. Two small windows in the back are a great improvement, and the building would be better framed to take the windows.

Stops must be fixed round the openings to form rebates to take the sashes, those at the sides and top being simply a chamfered moulding of the necessary width, as shown in Fig. 85; but that at the bottom should be as in Fig. 86, to form a stop to prevent the water driving in and over. The sashes are simply a square frame to fit each opening, made of ordinary sash moulding to take the glass. They are hinged on opposite sides, one opening to the right and the other to the left, and are

fixed and adjusted by means of ordinary casement stays.

The inside of the sanatorium is lined throughout with three-ply birch $\frac{1}{8}$ in. in thickness, the joints and also the angles being covered with a half-round moulding. This method of lining makes it practically draught-proof, while it is easy to do, and is not costly. It can be finished in any style, paint or stain, the former preferably, unless the stain is varnished. If this is done, outside varnish should be used, the inside being really in a great measure exposed to the weather sufficiently to call it outside. To prevent damage to the three-ply lining at the floor level, it will be as well to fix a narrow skirting entirely round the inside, on the face of the thinner wood. Two photographs of the completed building are shown in Figs. 87 and 88.

PORTABLE WORKSHOP

The method of construction of a workshop or storeroom building measuring 24 ft. long by 18 ft. wide, of a portable nature, would be first to prepare to a rectangular shape the concrete foundation, spacing the $\frac{3}{4}$-in. holding-down bolts, with their 6-in. by 6-in. by $\frac{1}{2}$-in. anchor plates, as shown in the longitudinal and transverse sections, Figs. 90 and 91, and also in Fig. 92. Protection must be provided for the screw thread and the nut at the top in the form of sacking, tied tightly on, and temporary boarding, bored with $\frac{3}{4}$-in. holes the correct distances apart to keep the bolts upright and in proper position, should be fitted and maintained while the concrete and brickwork is being put in. The concrete should be of about 4 to 1 proportions. A dampcourse composed of either asphalte, slate, or heavily tarred felt is an essential provision if the lasting qualities of the timber superstructure are to be considered, and this should be laid both horizontally and vertically. The brick base is then built and should be well grouted in with the mortar as the work rises. All these matters are shown in the detail drawing, Fig. 92.

The upper part of the building should be of good quality deal or fir, and all the sections should be strongly mortised and tenoned together, spiking being only resorted to where absolutely unavoidable. The main erection, as will be seen from the plan of the floor in Fig. 89 at A, is of 4-in. by 3-in. angle-posts, and 6-in. by 2-in. to carry the roof trusses, with 4-in. by 3-in. forming the door posts. The sections are of 4-in. by 2-in., being placed into position, and bolted with $\frac{1}{2}$-in. bolts to the 6-in. by 2-in. constructional uprights, etc. The bolting at the angles is arranged by allowing one bolt to be at a trifle lower level than the other to permit it to pass (*see* Fig. 91, sectional elevation E). Reference to Fig. 89 at A will clear up any point on this matter.

The sectional panels, which measure about 8 ft. by 9 ft. 6 in., are framed complete with the casement windows fitted in them, and these, by carefully arranging the galvanised-iron sheeting in width as well as height, can be taken out and replaced at will upon the simple removal of the $\frac{1}{2}$-in. bolts. It is obvious that the two end panels would have to be fixed first, and the centre one with the laps in width of the corrugated iron provided on each side of it afterwards.

Galvanised corrugated iron should not be cut if possible to avoid doing so, and certainly not extensively, but the correct size and shape of the sheets required should be ordered from the works to ensure the galvanising covering entirely the surfaces, together with the edges. A shearing machine is the correct method of cutting this material, specially designed for the purpose, but these are not readily available. Small holes such as those for the projection of a window sill can be managed by the careful working of a hack saw. The other method, and the one usually resorted to, is by means of a cold chisel and heavy hammer. This, as can be well imagined, makes a very rough job, and the edges should be trimmed and filed up to a true line for exposed positions. These facts only accentuate the desirability of ordering carefully and accurately, and should it be a case of cutting as against giving an extra lap in the iron, to select

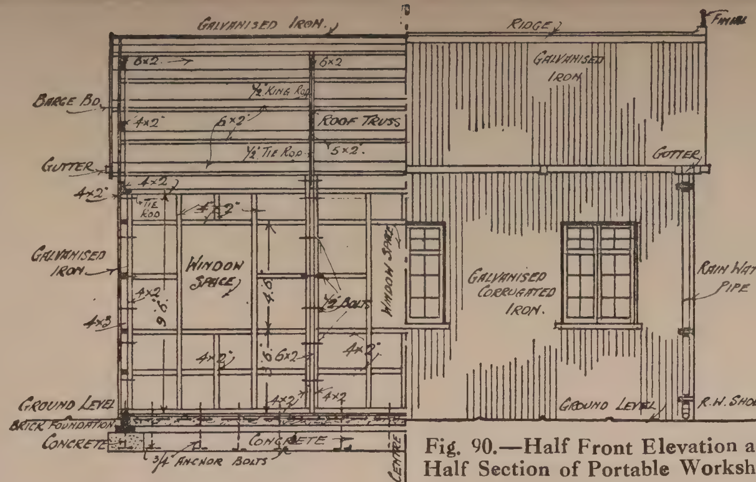


Fig. 90.—Half Front Elevation and Half Section of Portable Workshop

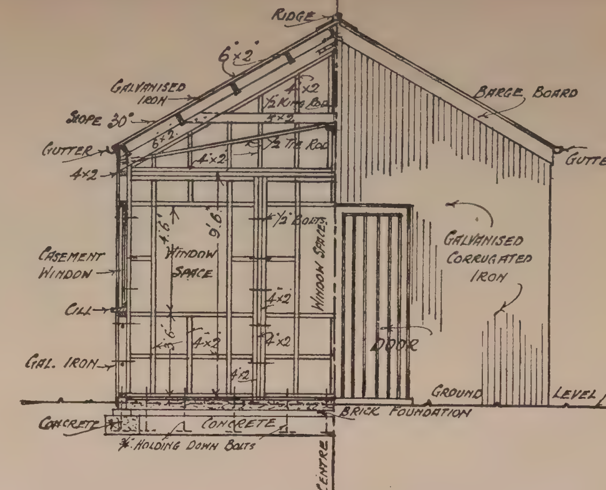


Fig. 91.—Half End Elevation and Half Section of Portable Workshop

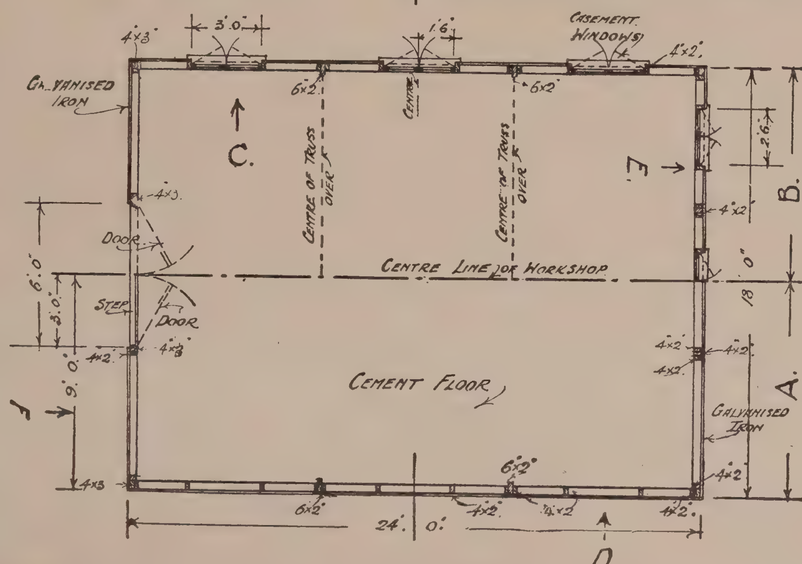


Fig. 89.—Half Plans of Floor and through Windows of Portable Workshop

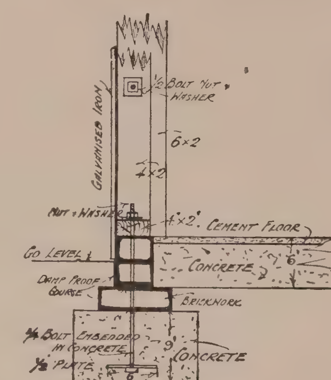


Fig. 92.—Detail of Base of Construction

the latter as the proper course, for weather acts on the ungalvanised edges, and the ends of the sheets rust away very rapidly.

It is well to arrange the building to enable stock size sheets to be used, and 24-gauge corrugated iron will be found

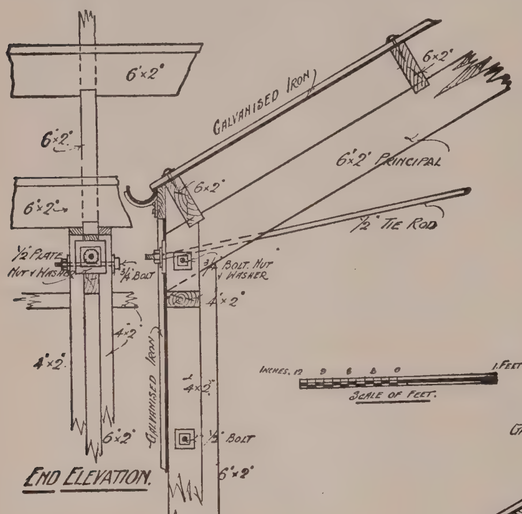


Fig. 93.—Detail of Eaves of Portable Workshop

sufficient for all ordinary purposes. A list of sizes can be easily obtained on application to the manufacturers. Fig. 89, at B, gives a half plan through the windows and doorway, which is arranged 6 ft. wide in two widths. Three windows are provided each side and at the back, which should prove sufficient lighting for ordinary purposes. However, one extra each side of the doorway could be inserted if, for instance, working benches are situate there.

Before proceeding to put on the roof, the assembling of the made sections (of which there are eleven) and fastening them together should be complete. They are simply passed over the holding-down bolts through the holes corresponding in position with the same in the 4-in. by 2-in. sill, washered, and the nuts tightened up, which is followed by the bolting up of the sides. The introduction of a ½-in. tie rod across the front of the building inside, over the door, would be a wise precaution so as to tie this end securely together.

A light form of roof is shown, but an ordinary king-post truss would suffice if it is desired to keep the constructional part of the erection particularly in timber. The span is not enough to introduce the bow-string kind of truss. It is a cheap, strong type of truss, consisting, as is seen in Fig. 91, transverse section, of 6-in. by 2-in. principal rafters, 5-in. by 2-in. collar halved into same with the ½-in. king and tie rods. Each is made as one section and slipped in between the extended 4-in. by 2-in. sides of the side panels, and on to the 6-in. by 2-in. upright, and then

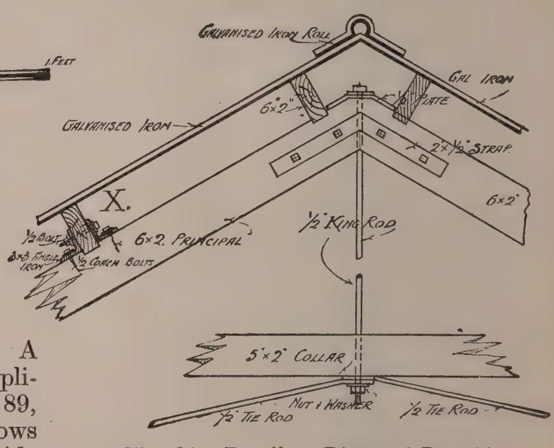


Fig. 94.—Detail at Ridge of Portable Workshop

securely bolted through the three thicknesses. The end elevation (Fig. 93) shows this point very clearly. Further explanatory details of the roof trusses are illustrated in Figs. 93 and 94, and will be easily followed and understood from them. On these trusses 6-in. by 2-in. purlin rafters are notched down parallel to the length of the workshop on to them at 2-ft. 6-in. intervals, and then in turn the galvanised corrugated iron is secured to same by galvanised pins each provided with a washer on top.

Fig. 94 at the point X shows a way by

which the roof can be placed on in sections. Each principal rafter of the trusses is provided with two 3-in. by 3-in. angle irons as shown, drilled to receive the ½-in. bolts through the same to secure the purlins rafters and similarly drilled to enable the coach bolts to be screwed into the principal rafters. The rafters and the sheets of iron fastened to them are removed by lifting as soon as the bolts through the angle cleats are taken out. The two end sections would have to be fitted first, and then the centre one. The roof in this case is portable and in six pieces. The 2½-in. rain-water pipes, 4-in. half-round gutters, ridge pieces, and barge boards are separate portions, and must be treated as such.

In Figs. 90 and 91 half front elevation and side elevation are given, and, as will be seen, the appearance complete would not be at all objectionable. The floor is shown to be in concrete with cement floating, but this, together with the provision for ventilation, etc., is dependent entirely upon the class of user. Other minor points will be easily cleared up by reference to the drawings, which to a large extent are self-explanatory. The letters on the plans (Fig. 89) apply to the other illustrations for reference and to facilitate the reading of them.

Wheelbarrows

EASILY-MADE BARROW

THE useful barrow shown by Figs. 1 to 4 can be made with few tools. All the work is quite straightforward, and has been greatly simplified by the introduction of a solid-wood wheel in place of the usual spoked wheel. A plan of the barrow is shown by Fig. 6.

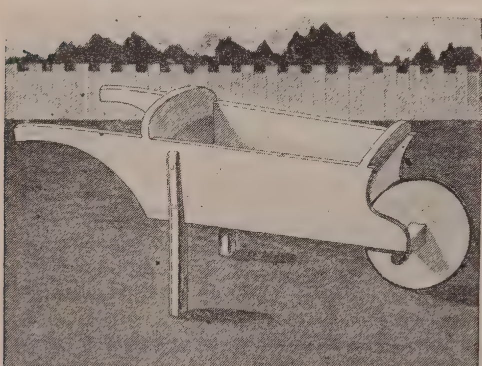


Fig. 1.—Sketch of Easily-made Barrow

In making, it is best to employ English elm, but a barrow made of good red deal is very serviceable and will last quite a number of years. The sides, back, front, and bottom should all be 1 in. thick. The sides are cut as shown in Fig. 5, and the top and bottom edges are bevelled to the side bevel of the barrow. The back is cut as shown in Fig. 7, and the front as shown in Fig. 8. Both the back and front are housed $\frac{1}{4}$ in. into the sides, and are fixed by driving screws through the sides. The bottom fits between the sides, and against the bottom edges of the back and front. It is fitted in from the back, and when in position screws are driven through the sides into the edges of the bottom, and others inserted through the bottom into the edges of the back and front.

The legs should, if possible, be of ash $1\frac{1}{2}$ in. square, shaped as shown by Fig. 9. They are bolted to the sides of the barrow, and may either be fixed square with the bottom, as shown in Fig. 2, or square with the ground. Neat chamfers about $\frac{1}{4}$ in. wide worked on the edges of the legs will improve the appearance.

The wheel is 1 ft. 2 in. in diameter by 1 in. or, if possible, $1\frac{1}{4}$ in. thick, having an iron tyre of either flat or half-round section $\frac{3}{8}$ in. thick. The tyre is welded slightly smaller in circumference than the wheel. It is heated for driving on, and when in place is cooled down. Three nails or screws are driven through the tyre. The hub is shown by Fig. 10; it is 10 in. long by $2\frac{1}{2}$ in. square, shouldered down to 2 in., and mortised through the wheel. The ends of the hub are rounded down to $1\frac{1}{2}$ in., and iron ferrules, as shown by Fig. 11, are driven on the ends. The wheel revolves on iron pegs $\frac{1}{2}$ in. in diameter, and similar to that shown by Fig. 12, driven into the ends of the hub. The wheel is held in

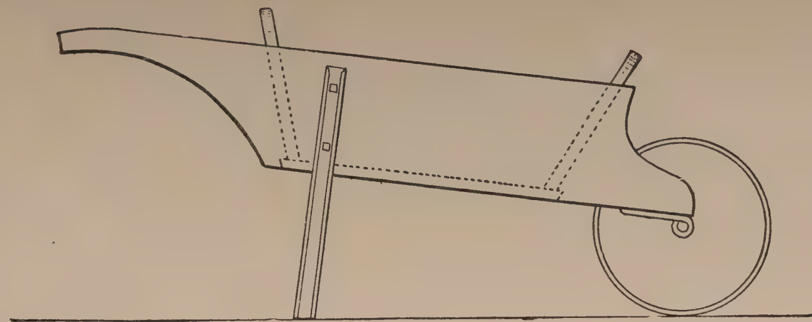


Fig. 2.

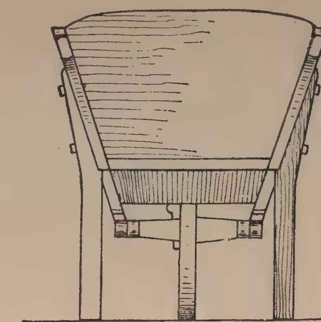


Fig. 3.

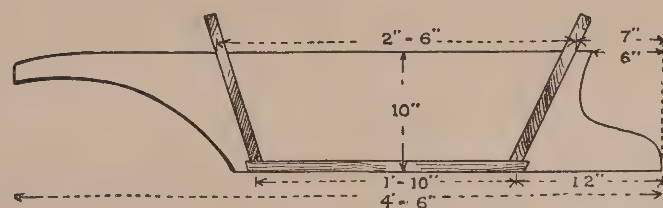


Fig. 5.

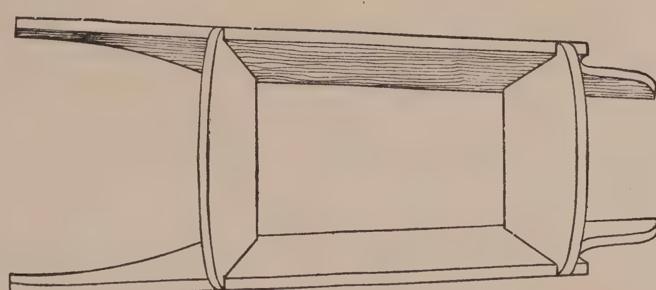


Fig. 6.

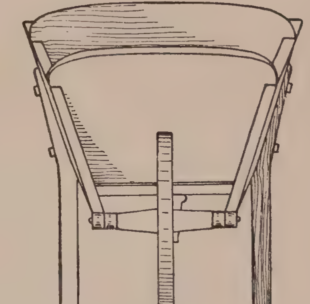


Fig. 4.

Figs. 2 to 4.—Side, Back and Front Elevations of Easily-made Barrow

Fig. 5.—Longitudinal Section

Fig. 6.—Plan

position on the hub with a key, as shown by Fig. 13, which is mortised through the hub. The wheel is attached to the barrow and works in two iron eyes, as shown by Fig. 14, which are turned up from iron 1 in. wide by $\frac{3}{8}$ in. thick, each eye being provided with two screw holes.

The painting of the barrow must not be overlooked, quite three good coats being necessary, green for the outside and red inside being usual colours.

GARDEN OR STABLE WHEEL-BARROWS

Garden barrows and farm or stable barrows are alike, except that the former have removable top boards for carrying leaves, etc., large bodies fairly wide at the front being required for both purposes. Two standard patterns will be dealt with, the first one a full-size barrow of substantial build being shown in side elevation by Fig. 15. Fig. 16 is a front elevation of the barrow, and Fig. 17 a plan as seen from underneath.

For the framework, English oak and ash are most suitable, the former being more durable than the latter when exposed to alternate wet and dry weather; but it has the disadvantage of being heavier than ash and less elastic. The panels or linings may be of either elm or red deal, the latter being most suitable for the bottom boards as regards durability. When getting out the stuff, which should be well seasoned and free from large knots and checks, allowance must be made for waste in cutting to length and planing up, as the finished sizes will be given. The large timber merchants keep special barrow timber in stock. The following pieces will be required for the framework: Two crooked strines A, 5 ft. long by 3 in. deep by 2 in. thick; three sloats B, 1 ft. 11 in., 1 ft. $8\frac{3}{4}$ in., and 1 ft. $6\frac{1}{2}$ in. long respectively by $2\frac{1}{2}$ in. by $1\frac{1}{4}$ in.; two legs C, 2 ft. 4 in. long by $2\frac{1}{4}$ in. by $2\frac{1}{4}$ in.; two front

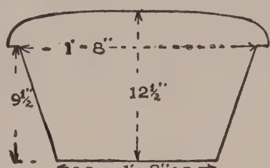


Fig. 7.

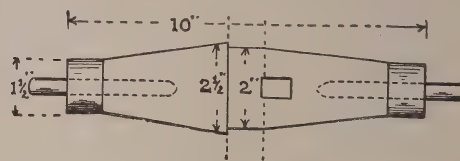


Fig. 10.—Wheel Hub

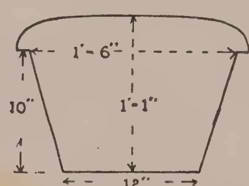


Fig. 8.

Figs. 7 and 8.—Back and Front of Barrow

Fig. 13.—Key

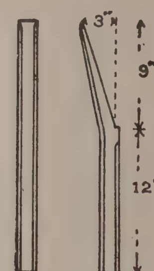


Fig. 9.—Barrow Legs


Fig. 11.—Iron Ferrule for Hub

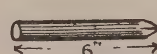


Fig. 12.—Wheel Spindle

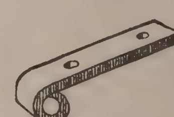


Fig. 14.—Iron Eye for Wheel

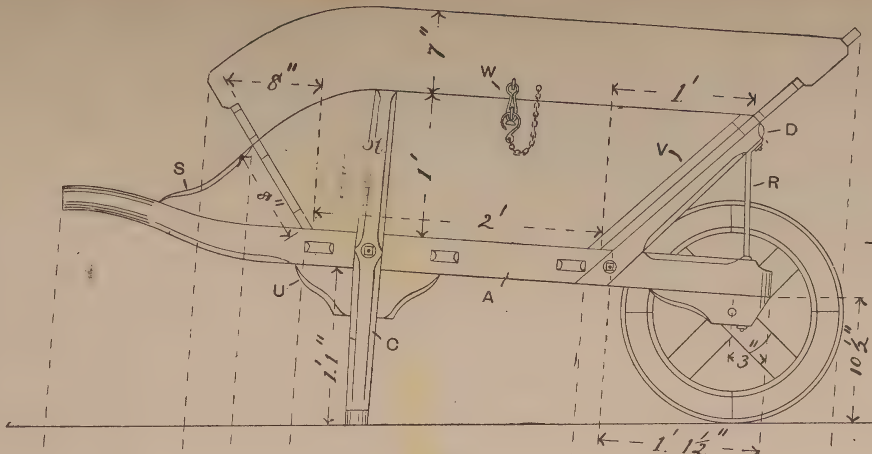


Fig. 15.

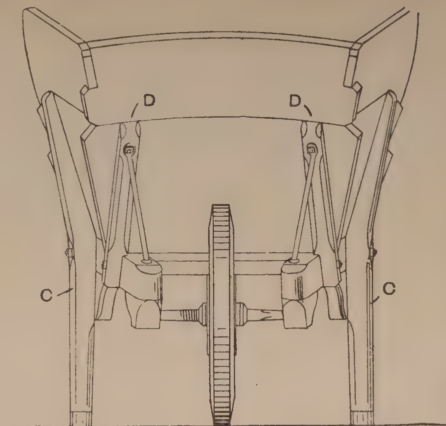


Fig. 16.

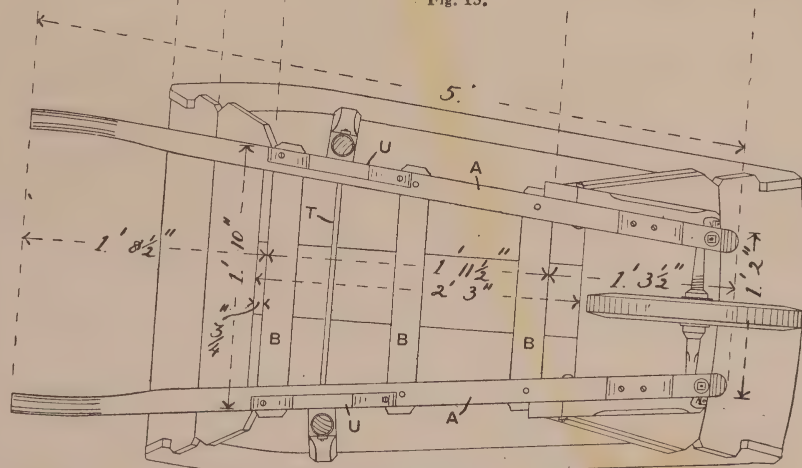


Fig. 17.

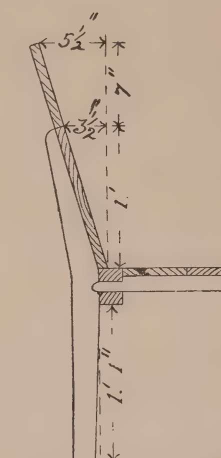


Fig. 18.

Fig. 15. — Side Elevation of Stable Barrow

Fig. 16. — Front Elevation

Fig. 17.—Plan

Fig. 18. — Cross Section of Side

standards D, 1 ft. $8\frac{3}{4}$ in. long by 2 in. wide by $1\frac{7}{8}$ in. thick; and 16-ft. run of $2\frac{1}{2}$-in. by 1-in. ash for the top board battens; also 2 ft. of $2\frac{1}{2}$-in. by 2-in. oak for the trunnion blocks.

The principal dimensions of the barrow are as follow: Length inside at bottom, 2 ft.; ditto at top, 3 ft. 5 in.; width at bottom inside, 1 ft. $8\frac{1}{4}$ in. at back and 1 ft. $3\frac{1}{8}$ in. at the front; vertical depth of sides, 1 ft.; ditto of top boards, 7 in.; splay of sides, $3\frac{1}{2}$ in.; splay of front panel or head, 1 ft. or 45°; splay of back panel, 8 in. in 1 ft.; capacity of body without top boards, 5 cub. ft. The width of the bottom frame over the strines is 1 ft. 2 in. at the front, and 1 ft. 10 in. at the back of the hind sloat. The length on the centre line of the plan from the front end of the strines to the front sloat is 1 ft. $3\frac{1}{2}$ in.; over the front and back sloats, 1 ft. $11\frac{1}{2}$ in.; and from hind sloat to end of handles, 1 ft. $8\frac{1}{2}$ in.

Having planed up the stuff true to size and out of wind, place the strines on the floor the required distance apart and the sloats across them in their respective positions, using small cramps to keep them in position, testing for truth with a waxed line diagonally across opposite corners until found correct. Then scribe the position of the mortises on the strines and the shoulder on the sloats. The sloats are made with bare-faced tenons $\frac{3}{4}$ in. thick, the shoulder being on the upper side, so that the $\frac{5}{8}$-in. bottom boards will come flush at the top with the strines as shown in the cross-sectional view (Fig. 18). Square lines on both sides of the strines from the marks previously made, and gauge the width of the mortises from the upper edge.

Having cut the mortises and tenons, bore a $\frac{1}{4}$-in. pinhole through each mortise, and knock the frame together temporarily to see whether it is true, testing again with the waxed line. When true, scribe the position of the pinholes on the tenons, take the frame apart, and bore the holes a trifle nearer the shoulder to give the joints a little draw and ensure the shoulders coming up tight. After dressing the handles to shape, and rounding the ends of the tenons on the sloats, which project $\frac{1}{2}$ in. from the face of the strines, give all the joints a good coat of white-lead mixed with linseed oil, and fix together permanently with lancewood or hickory pins.

The bottom boards, 2 ft. 3 in. long, run longitudinally between the strines, and are nailed to the sloats, the ends of the boards being rounded. To set out the front and back panels, first mark the inside length of the body on the frame as at E and F (Fig. 19), then the amount of splay, namely, 1 ft. at the front and 8 in. at the back, fixing two straightedges G and H at the two latter marks by means of cramps or wire nails. Then place another straightedge J across the others at a distance of $3\frac{1}{2}$ in. from one of the strines and parallel with it, marking the inner edge where they cross at K and L, repeating the operation for the other side.

Next obtain the width of board required for the front and back by setting them out on a board to the given splay, as shown in Fig. 15, which is 1 ft. $6\frac{1}{4}$ in. for the front panel and 1 ft. $2\frac{1}{4}$ in. ($8\frac{1}{2}$ in. + $5\frac{3}{4}$ in.) for the back panel. Having planed the stuff and shot the edges true, gauge a line $1\frac{1}{2}$ in. from the upper edge of the front panel, this being the amount of camber, and, with square and scriber, strike a centre line M (Fig. 20) across the board. Then take the outside width across the bottom at F F and the width across the top at L L (Fig. 19), divide by 2, and set off the measurements obtained on each side of the centre line at F F and L L (Fig. 20), afterwards drawing lines from F to L for the required bevels. For the back panel, take the widths E E and K K (Fig. 19), setting off half their respective lengths on each side of the centre line in Fig. 21, and drawing the bevels through the points obtained. Then gauge the true width $8\frac{1}{2}$ in. up from the bottom as shown by line N. As the front and back panels project $1\frac{1}{4}$ in. over the sides, scribe parallel lines O that distance from F L (Fig. 20) and E K (Fig. 21).

The top swept line P (Fig. 20) is struck by first inserting a bradawl at each side L, and another in the centre at Q, then nailing two crossed laths together, their

edges touching the three awls, as shown by Fig. 22. Then by withdrawing the centre awl, but holding it in the same place as a scriber, move the laths round from one side to the other, as indicated by dotted lines, the scriber bearing lightly on the panel. The end bevels are obtained by first bevelling the bottom edge to the given splay, then setting the bevel to the taper of the bottom frame and applying it to the inner or acute bottom edge of the panels, as shown by Figs. 23 and 24, from which points lines are scribed on the face to the same bevel as those on the back. The front standards taper at the top to $1\frac{3}{4}$ in. wide by $\frac{7}{8}$ in. thick, and are shoul-

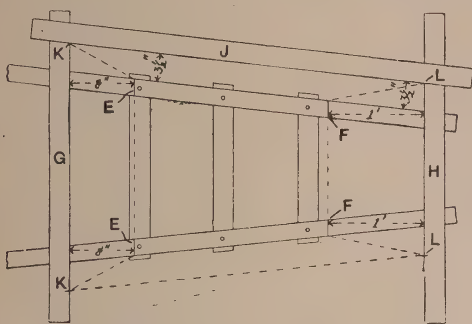


Fig. 19.—Plan of Bottom Frame of Stable Barrow

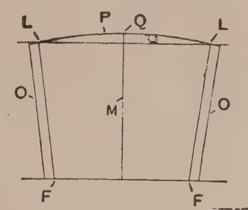


Fig. 20.—Setting-out Front Panel

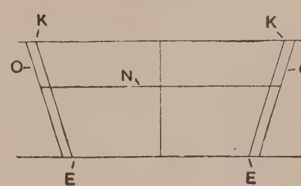


Fig. 21.—Setting-out Back Panel


Fig. 25.—Inside View of Side Board

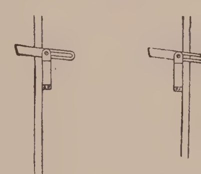


Fig. 23. Fig. 24.

Figs. 23 and 24.—Bevels Applied to Bottom of Back and Front Panels

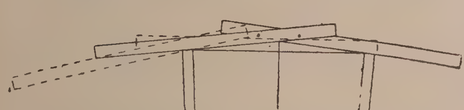


Fig. 22.—Method of Drawing Swept Top Line of Front Panel

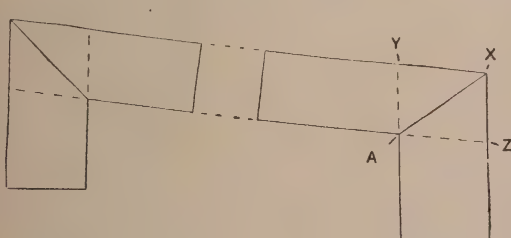


Fig. 27.—Setting-out Mitres for Top-board Battens

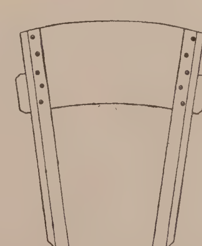


Fig. 26.—Inside View of Front Board

dered down $\frac{5}{8}$ in. at the bottom, where they are lapped to the face of the strines and secured with $\frac{5}{16}$-in. bolts.

The head is supported by braces R (Fig. 15) of $\frac{7}{16}$-in. round bar iron with a flap at the top and a $\frac{5}{16}$-in. bolt through it and the standard, the $\frac{3}{8}$-in. bolt-end at the bottom taking the strine and trunnion block, the latter being further secured with screws. The holes for the axle are only bored $1\frac{1}{2}$ in. deep, and should be lined with pieces of iron tubing an easy fit on the ends of the axle. The back panel is supported by brackets S (Fig. 15) $1\frac{1}{8}$ in. thick, fixed to the strines with dowels and screws. Having nailed the front and back panels in position, the side panels can be marked from them after bevelling the bottom edge. Place the side panels on the side of the barrow with the lower edge level with the top of the frame, and scribe on the inner side along the ends of the front and back panels to get the correct length and shape. Then mark the end bevels on the lower edge, continuing the lines on the face to the same bevel as those scribed on the back, so that there will be no mistake when cutting to shape and dressing the ends.

Dress the legs to the side splay as shown in Fig. 18, and taper them to 2 in. by 2 in. at the bottom and 2 in. by $\frac{7}{8}$ in. at the top, chamfering the edges where they do not bear against anything. The legs are fixed to the face of the strines with a $\frac{3}{8}$-in. long-bolt T (Fig. 17) and $1\frac{1}{8}$-in. brackets U. The lower ends of the legs are shod with hoops of 1-in. by $\frac{1}{8}$-in. iron. Fillets V (Fig. 15) $1\frac{1}{4}$ in. by $\frac{3}{4}$ in. are fixed across the front panel close to the ends to strengthen the side panels and form a better fixing for them.

The removable top boards are held in position by a long batten at each end, fixed to the back with screws, as shown by the inside views of a side and front board (Figs. 25 and 26 respectively), the battens extending to the bottom of the body, and mitre-jointed to those of the adjacent boards, which prevents their falling outwards. The top boards are halved together edgewise at the corners, the end boards being inserted first, then the side boards, which are fitted with a hasp and staple W (Fig. 15) secured with a pig-tail or hook cotter attached to a chain, thus locking the whole securely.

The easiest way of obtaining the correct bevels for the mitres will be to place the battens in the inside corners of the body, and mark and cut the bevels at the foot to fit perfectly level on the bottom boards. Then mark the thickness at the foot of the ends battens on the foot of the side battens from X to Y (Fig. 27), and the thickness at the foot of the side battens on the foot of the end battens from X to Z. With the bevel as previously set (Figs. 23 and 24), draw lines across to A (Fig. 27), taking care to place the blade the right way. Join A to X, and gauge the width on the inner side of the batten. The bevel is held the opposite way for the other end of the barrow, as on the left of Fig. 27.

The wheel is 1 ft. 6 in. high in the wood main spoke, $2\frac{1}{2}$ in. by $1\frac{7}{8}$ in.; the other one, $2\frac{1}{2}$ in. by $\frac{3}{4}$ in.; felloes, $2\frac{1}{4}$ in. deep by 2 in. thick; tyre, $1\frac{1}{2}$ in. by $\frac{5}{16}$ in. The light spoke is mortised through the heavy one, the latter being dressed to $\frac{3}{4}$ in. thick at the ends. The axle, of 1-in. square bar iron, has a solid collar $1\frac{3}{4}$ in. square by $\frac{1}{2}$ in. thick on one side of the wheel, and a nut the same size on the other side, a $2\frac{1}{2}$-in. by $\frac{1}{8}$-in. washer being interposed between the nut and the spoke. The ends of the axle are rounded to $\frac{3}{4}$-in. diameter.

ALTERNATIVE DESIGN FOR BARROW

Another design of wheelbarrow, of medium size, is given in side elevation by Fig. 28, and in front elevation by Fig. 29. Fig. 30 is a plan of the bottom frame, and Fig. 31 a sectional elevation of the body, Fig. 32 being a cross section through one leg.

The framework of this barrow consists of two strines B, 4 ft. 5 in. long by $2\frac{3}{4}$ in. deep by 2 in. thick; a front sloat C, 1 ft. $6\frac{1}{2}$ in. long by $3\frac{3}{4}$ in. wide by $1\frac{1}{4}$ in. thick; a hind sloat D, 1 ft. 9 in. long by $2\frac{1}{2}$ in. wide by $1\frac{1}{4}$ in. thick; two legs E, 2 ft. $\frac{3}{4}$ in. long by 2 in. by 2 in.; two front pillars F, 1 ft. $7\frac{1}{2}$ in. long by $1\frac{1}{2}$ in. wide by $1\frac{1}{4}$ in.

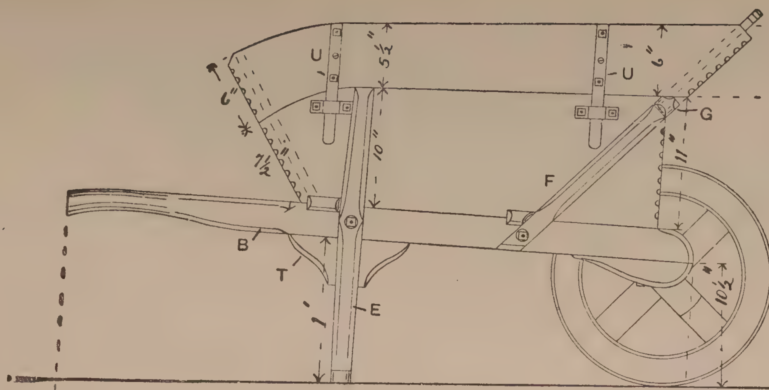


Fig 28.

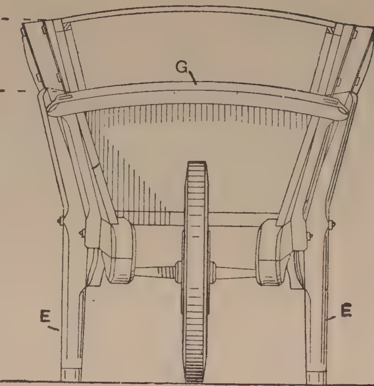


Fig. 29.

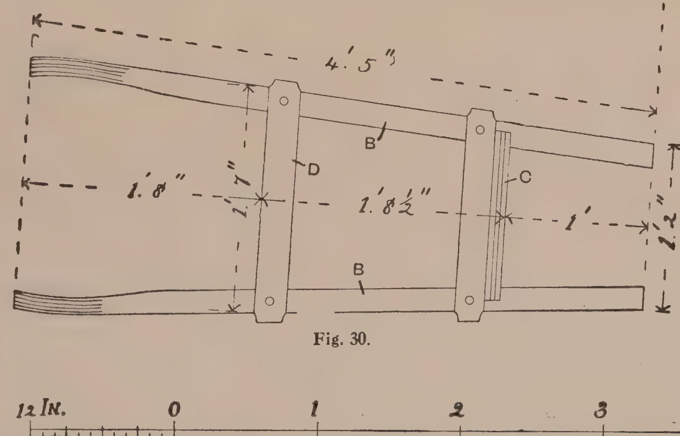


Fig. 30.

Figs. 28 and 29.—Side and Front Elevations of Barrow of Alternative Design

Fig. 30.—Plan of Bottom Frame

thick; and a front cross-rail G, 2 ft. 2 in. long by $1\frac{1}{2}$ in. wide by $1\frac{5}{8}$ in. deep, compassed to $1\frac{1}{2}$ in. at the centre; also 2 ft. of $2\frac{1}{4}$-in. by 2-in. oak for the trunnion blocks.

The principal dimensions are as follow: Length inside at bottom, 1 ft. 6 in.; splay of front, $9\frac{3}{4}$ in.; splay of back, $4\frac{1}{4}$ in. in its own depth; vertical depth of side, 11 in. at the front, 10 in. at the leg, and $6\frac{1}{2}$ in. at the back; width of board for back panel $7\frac{3}{4}$ in.; width of bottom inside, 1 ft. $5\frac{1}{8}$ in. at back and 1 ft. $2\frac{3}{8}$ in. at front; splay of sides, $3\frac{1}{2}$ in. at the leg; vertical depth of top boards, 6 in. at the ends and $5\frac{1}{2}$ in. at the leg; capacity of body without top boards, 3 cub. ft. The width of the bottom frame over the strines is 1 ft. 2 in. at the front and 1 ft. 7 in. at the back of the hind sloat. The length on the centre line of the plan from the front end of the strines to the front sloat is 1 ft.; over the sloats, 1 ft. $8\frac{1}{2}$ in.; and from the hind sloat to the end of the handles, 1 ft. 8 in.

The bottom frame is marked out as previously described. The sloats and strines are let into each other $\frac{5}{16}$ in., as shown by Fig. 33, the sloats standing $\frac{5}{8}$ in. above the strines to come flush with the top of the bottom boards, which run crosswise between the sloats. The front sloat is grooved $\frac{1}{2}$ in. from the front edge for the $\frac{5}{8}$-in. front boards H (Fig. 31), the ends of the sloat being cut, as shown by the enlarged view (Fig. 34), to the angle of the front pillars, the back of which falls in line with the back of the front boards. The ends of the sloats project 1 in. over the strines, and after being rounded in and shaved out, the joints are given a coat of white-lead before they are finally fixed together with $\frac{5}{16}$-in. bolts.

To make the front pillar pattern, first take the length at the front from the top of the strine to the shoulder at the upper end from Fig. 28, and set it off on the edge of a board as at J K (Fig. 35), also the total length of the foot at L. Then take the vertical height at the shoulder from Fig. 28, set it off on the vertical dotted line M (Fig. 32), and square a line across to the splayed side line. The distance between the vertical and splayed lines at this point is the amount of splay required for the pillar, which must be set off on a line squared from K (Fig. 35), as at N. Join J and N, and mark in the thickness $1\frac{1}{4}$ in.

After the pillars have been cut to pattern a horizontal square (Fig. 36) will be required in dressing the inner side to the required bevel. The steel blade O is securely fixed to the end of a bolt, which turns in a gunmetal stock P, the blade being fixed to any angle by means of a knurled nut Q. To use the square, first draw a number of horizontal lines across the front edge of the pillars as shown, hold the stock of the square parallel to one of the lines, and swing the blade round to a horizontal position when the pillar is inclined to the front splay, as shown by the lower shoulder line R (Fig. 35) on the inner side of the pillar, securing it by tightening up the nut. Then dress the inner side of the pillars to the square from point to point, holding the stock to the horizontal lines on the front.

Dress the legs to the side splay obtained from Fig. 32, making them $1\frac{3}{4}$ in. by $\frac{7}{8}$ in. at the top and $1\frac{3}{4}$ in. by $1\frac{3}{4}$ in. at the bottom. Having prepared the panels, which are $\frac{3}{4}$ in. thick, bevel the bottom edge of the side ones to suit the side splay, and mark on them the forward splay of the front pillars, also the position of the sloats. Notch out the lower edge of the panels to fit over the sloats, place the front pillars to the splayed lines, and fix them temporarily with a couple of screws at the back. Fix the legs temporarily in position on the frame with $\frac{3}{8}$-in. bolts, and also the side panels, and pillars, securing the latter with cramps, or, if preferred, with the $\frac{5}{16}$-in. bolts by which they will be afterwards fixed permanently. Then by placing a straightedge across the front of the pillars at the top, the amount to be dressed off to make them level with the top cross-rail can be measured, which will be barely $\frac{1}{16}$ in., as the pillars are slightly on the twist.

Having taken off the pillars and dressed the front edge to line at the top, mark the tenons from the inner side and gauge them from the front across the top, when they will have the requisite amount of twist to

line with the cross-rail. As the front cross-rail is compassed $1\frac{1}{2}$ in., the shoulders on the pillars should be marked to correspond, although they will be almost square. Also mark the inclination of the tenons on the rail. After mortising, place the project $1\frac{1}{4}$ in. Give the joints a coat of white-lead and fix together, either screwing or nailing the panels to the pillars and legs.

The front ends of the side panels are fixed to the strines with half-round strap-

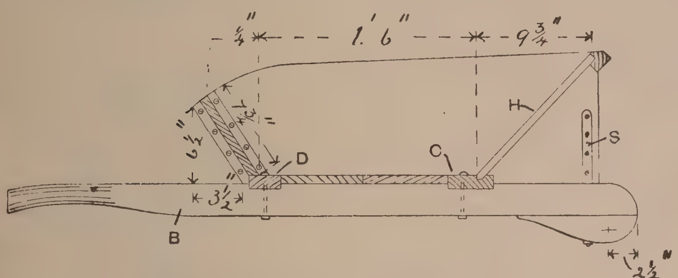


Fig. 31.—Sectional Elevation of Body

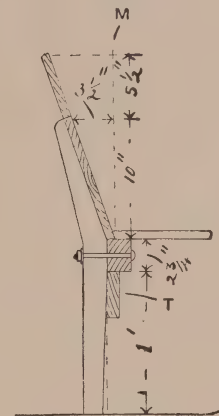


Fig. 32.—Cross Section at Leg

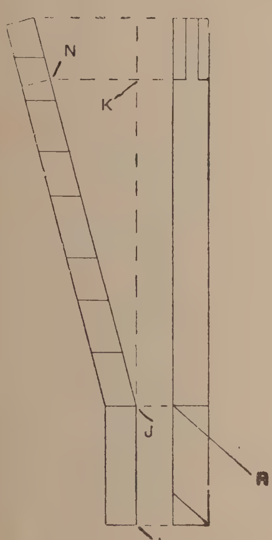


Fig. 35.—Method of Setting-out Front Pillars

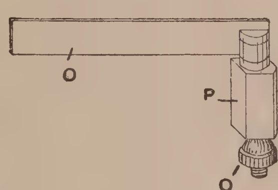


Fig. 36.—Horizontal Square

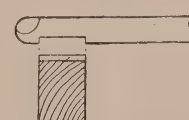


Fig. 33.—Bottom Frame Joint

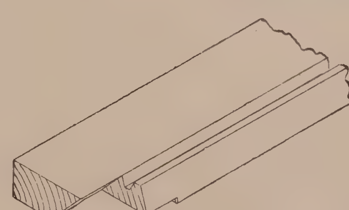


Fig. 34.—End of Front Sloat Before Rounding

sides, pillars, and rail in position, marking all bearings, also the pinholes on the tenons, then take apart, box out the inside bottom edge of the rail $\frac{5}{8}$ in. deep by $\frac{3}{4}$ in. on, for the front boards, and chamier the edges as desired, rounding in and shaving out the ends of the rail, which bolts S (Fig. 31), which also take the trunnion blocks, the latter being further secured with screws. The front boards are $\frac{5}{8}$ in. thick, and run the same way as the pillars, the bottom ends fitting into the groove in the front sloat, and the top ends into the boxing in the cross-rail to

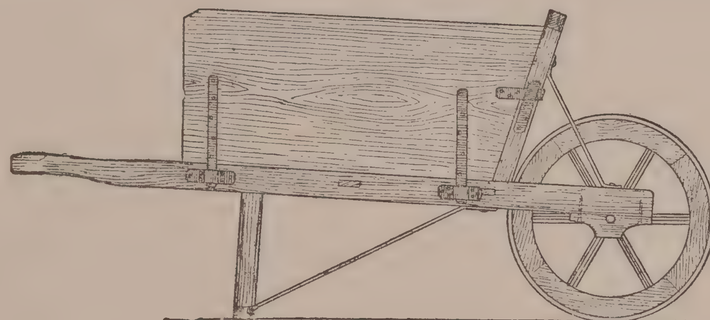


Fig. 37.—Side Elevation of Barrow with Movable Sides

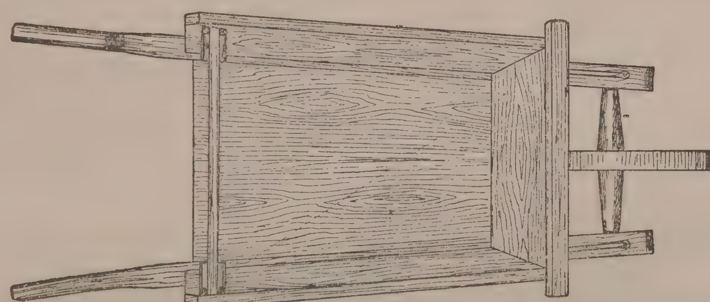


Fig. 38.—Plan of Barrow with Movable Sides

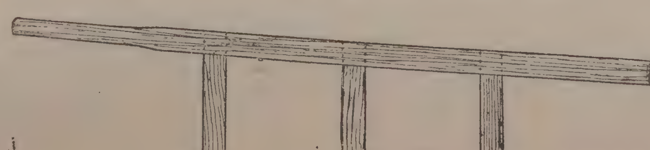


Fig. 39.—Half Plan of Framing of Bed

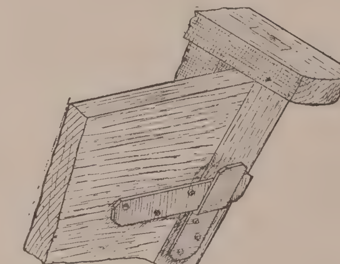


Fig. 41.—Strap and Hook for Holding Side to Front

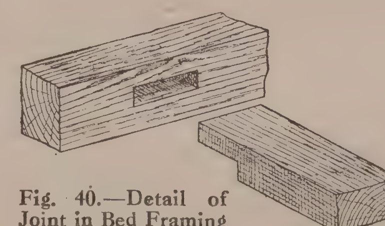


Fig. 40.—Detail of Joint in Bed Framing

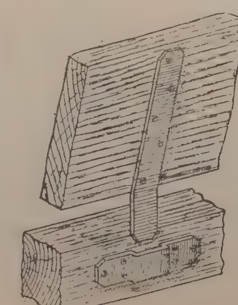


Fig. 42. Strap and Socket for Holding Side to Shaft

which they are nailed. The projecting upper corner of the top rail is dressed off level with the top of the side panels. The bottom boards, $\frac{5}{8}$ in. thick, are next fitted and nailed to the strines.

The back panel can either be made to slide in and out between $\frac{3}{4}$-in. by $\frac{5}{8}$-in. fillets screwed to the side panels, as shown in Fig. 31, or it can be a fixture; but there is not much advantage in making a low back removable. When the back is removable, the legs require staying to prevent the sides of the body spreading. The legs are strengthened by means of wood brackets T (Fig. 28) firmly screwed in position.

The portable side boards, $\frac{3}{4}$ in. thick, are attached with 1-in. by $\frac{3}{16}$-in. iron plates U, which drop into staples made from the same bar and fixed to the side panels with $\frac{1}{4}$-in. bolts. When fixing the upright irons to the side boards, care should be taken to place them parallel with each other, otherwise they will not drop into position. The loose front and back boards are battened at the back, and slide down between $\frac{3}{4}$-in. by $\frac{5}{8}$-in. fillets screwed to the side boards.

The wheel is the same as described for the other barrow.

A WHEELBARROW WITH MOVABLE SIDES

An easily constructed barrow with movable sides is shown by Figs. 37 and 38. The sizes can be easily obtained from the illustrations, which are reproduced to a scale of $\frac{3}{4}$ in. to a foot, except the details (Figs. 40, 41, and 42), which are twice that size; but these can be modified to meet requirements. Suitable woods are, ash for the framework, and oak, poplar, or best red deal for the boarding.

The framing is mortised and tenoned together, Fig. 39 being half plan of framing of bed, and Fig. 40 an enlarged detail of one of the joints. From the latter figure it will be noticed that the rails have barefaced tenons. The legs and uprights of the front are tenoned into the under and upper sides of the shafts respectively, and are kept in position more rigidly with iron stays, which are about $\frac{5}{8}$ in. in diameter and forged at the ends for screw holes.

Figs. 37, 41, and 42 show the ironwork for holding the sides in position. The iron straps, $1\frac{1}{4}$ in. by $\frac{1}{4}$ in., are screwed to the sides, the vertical ones fitting into iron sockets screwed to the side of the shafts, and the horizontal straps fitting into hooks on the uprights of the front framing. To hold the backboard in position, fillets are screwed to the barrow sides. The construction of the wheel should present no difficulties, the felloes being dowelled together, the spokes are tenoned into them, and the hub and the latter are bored for the axle, which runs in hardwood bearing blocks screwed to the shafts.

WHEELBARROW OF MODIFIED DESIGN

Wheelbarrows are usually very heavy things to use, for much of the weight is borne directly by the arms of the user. A barrow which has been designed with a view to obviate this is shown in side elevation in Fig. 43. It is so built that the greater part of the load is carried over the wheel, thus taking much of the weight off the arms. The barrow is also shorter than an ordinary one, and narrow enough to pass through a 2 ft. 6 in. doorway, this, together with the deep sides, being desirable features for stable use. Figs. 44 and 45 are back and front views respectively. Fig. 46 is a plan as seen from underneath, and Fig. 47 is a sectional elevation of the body.

Either oak or ash should be used for the framework, and the panels and bottom boards of elm or good red deal. The two strines A are 4 ft. 1 in. long by $2\frac{3}{4}$ in. deep by 2 in. thick; the two sloats B, 1 ft. $10\frac{1}{2}$ in. and 1 ft. $7\frac{3}{4}$ in. long respectively by $2\frac{5}{8}$ in. wide by $1\frac{1}{8}$ in. thick; two legs C, 2 ft. $2\frac{1}{2}$ in. long by 2 in. by 2 in.; and two standards D, 1 ft. $8\frac{1}{2}$ in. long by $1\frac{1}{2}$ in. by $1\frac{3}{8}$ in. The width of the bottom frame over the strines is 1 ft. 3 in. at the front and 1 ft. 9 in. at the back of the hind sloat. The length on the centre line of the plan, from the front end of the strines to the front sloat, is 1 ft. $\frac{3}{4}$ in.; over the sloats, 1 ft. $3\frac{1}{2}$ in.;

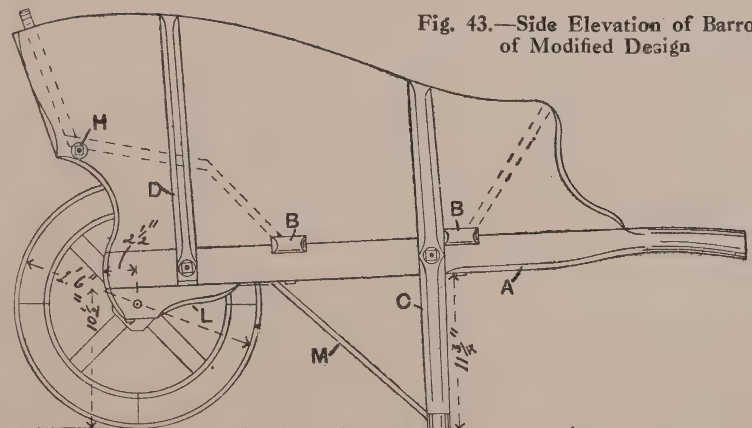


Fig. 43.—Side Elevation of Barrow of Modified Design

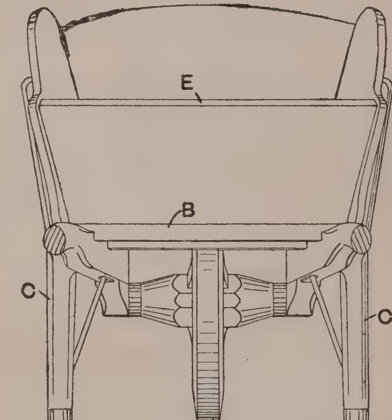


Fig. 44.—Back Elevation of Barrow

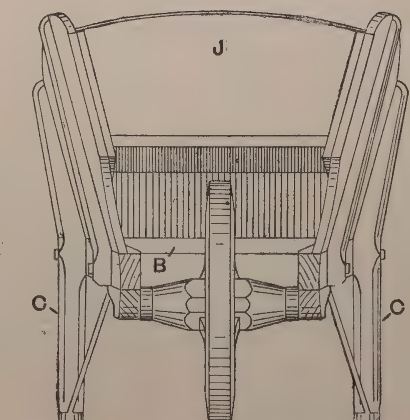


Fig. 45.—Front Elevation of Barrow

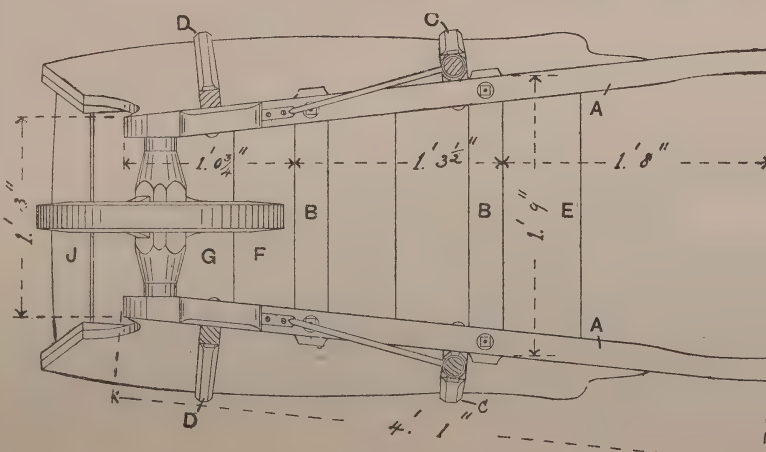


Fig. 46.—Plan of Barrow

from the hind sloat to the end of the handles, 1 ft. 8 in.

The strines and sloats are let into each other $\frac{1}{4}$ in. so that the latter stand $\frac{5}{8}$ in. above the former to come level with the top of the bottom boards, which run

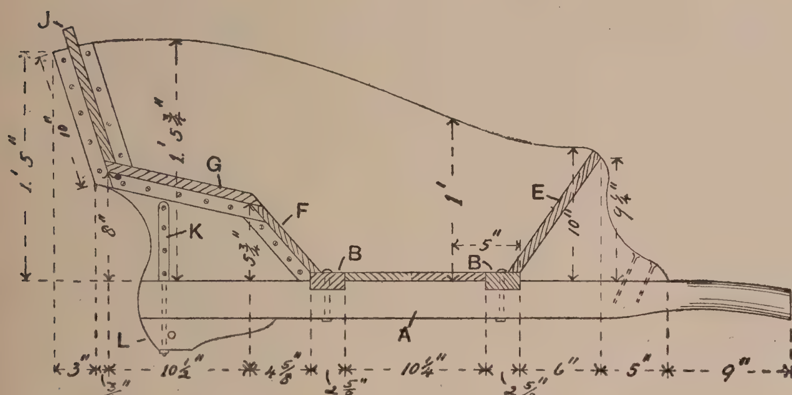


Fig. 47.—Sectional Elevation of Body

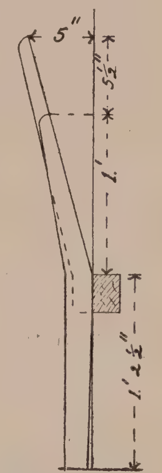


Fig. 48.—Side Splay of Leg and Standard

crosswise between the sloats, the frame being fixed together with $\frac{5}{16}$-in. bolts. The legs and standards are got out to the side splay obtained from Fig. 48, and is 5 in. in 1 ft. $5\frac{1}{2}$ in. The legs are tapered to $1\frac{3}{4}$ in. by $1\frac{3}{4}$ in. at the bottom, and $1\frac{3}{4}$ in. by $\frac{7}{8}$ in. at the top, the standards also tapering to $\frac{7}{8}$ in. thick at the top. The legs are fixed to the face of the strines with $\frac{3}{8}$-in. bolts, and the standards with $\frac{5}{16}$-in. bolts.

The length of the various sections should be taken from the side line on the plan, and the height or width of the board from the side splay line (Fig. 48), when setting out the side panels. The panels are all $\frac{3}{4}$ in. thick, the back panel E, 11 in. wide, being housed $\frac{3}{16}$ in. into the side panels and nailed in position, being strengthened with corner plates at the top. The raised front is fixed to $1\frac{1}{8}$-in. by $\frac{5}{8}$-in. fillets screwed to the side panels, the board F being $\frac{5}{8}$-in. thick, and the other one G $\frac{3}{4}$ in. thick. A $\frac{5}{16}$-in. long-bolt H extends across the front of the body, underneath the board G, embracing the side panels, to resist inside pressure. The front panel J, $10\frac{1}{2}$ in. wide, slides between fillets, and can be taken out to facilitate tipping the load. This panel should be battened at the back to prevent its splitting. At the front, a half-round strap-bolt K is fixed to the inner side of the side panels, with screws, the bolt taking the front end of the strines and trunnion blocks.

The trunnion blocks L are 10 in. by $2\frac{1}{4}$ in. by 2 in., their back ends being fixed with screws, and the trunnion holes lined with iron tubing. The legs are strengthened with stays M of $\frac{7}{16}$-in. round iron, the lower end being welded to the hoop on the leg.

The wheel is 1 ft. 6 in. high "in the wood"—that is, without the tyre; nave, 1 ft. long by $3\frac{1}{2}$ in. by $3\frac{1}{2}$ in.; one spoke, $3\frac{1}{4}$ in. by $1\frac{1}{4}$ in.; and the other one $1\frac{1}{4}$ in. by $1\frac{1}{4}$ in.; felloes, $2\frac{1}{4}$ in. by $2\frac{1}{4}$ in.; tyre, $1\frac{3}{4}$ in. by $\frac{5}{16}$ in.; trunnions of $\frac{5}{8}$-in. iron. The wide spoke is mortised through the centre of the nave and the square spoke at right angles, the wide spoke being then dressed to $1\frac{1}{4}$ in. in width at the ends. The tangs at the ends of the spokes should be $\frac{7}{8}$ in. in diameter.

Boxes for Special Purposes

STRONG WOODEN BOX

Fig. 1 is a general view of a strong wooden box of general utility. The box may be of oak, walnut, teak, mahogany, or other hardwood, and if made as here shown and polished, will have a good appearance. Fig. 2 is a longitudinal section. The dimensions are, of course, only suggestive, and can be varied to meet requirements. The thickness of the wood may be $\frac{1}{2}$ in. to $\frac{3}{4}$ in., according to the size and strength required.

Assuming that the material has been sawn to the various sizes and planed up true, the angles of the sides and ends should be set out for dovetailing. One of the best forms for this class of work is secret lap-dovetailing, as shown at Fig. 3. On the right hand piece about $\frac{1}{8}$ in. is allowed to project beyond the ends of the pins, and thus after the joints are glued together, the small amount of end grain can be rounded (as indicated at Fig. 4), which will show so little when polished as to be no detriment. The top edges of the sides and ends are tongued, as shown in Figs. 3 and 5, the top being grooved to receive these tongues, as shown in Fig. 6. Fig. 7 is a conventional view of a corner of the bottom, showing how its edges are tongued so as to slide in the grooves of the sides and ends in Figs. 3 and 8.

The fitting being satisfactory, the sides, ends, and bottom should be glued together, and the joints held close by cramps until the glue is dry. The top can next be glued on and cramped. The outside should then be smoothed off, and the angles (except the bottom) slightly, but neatly, rounded off. A neat finish to the bottom can be made by rounding the edge of a piece of stuff, mitreing, and gluing and screwing it on as shown. Before putting on the fillet, additional strength would be given to the box by inserting a few screws obliquely through the bottom into the sides and ends, as shown in section at Fig. 8.

A gauge should be set to the depth of the portion forming the lid, and a line marked round and then sawn. If this sawing is carefully done, an even shaving taken off each of the surfaces should be sufficient to leave the edges at once smooth and truly fitting. If desired, a small bead may be worked round the outside of the edge of the lid, as shown at Figs. 1 and 9. The lid should now be hinged, and as it is necessary for them to be of a strong character in such a box, chest hinges which screw on the inside, or ornamental flap hinges which screw on the outside are the most suitable. A handle and plate, in which the handle drops down flush when not in use as shown, should be neatly let into the lid as shown and fixed with screws. A suitable lock and staple should also be fixed on, as shown in Fig. 1. The box can then be polished.

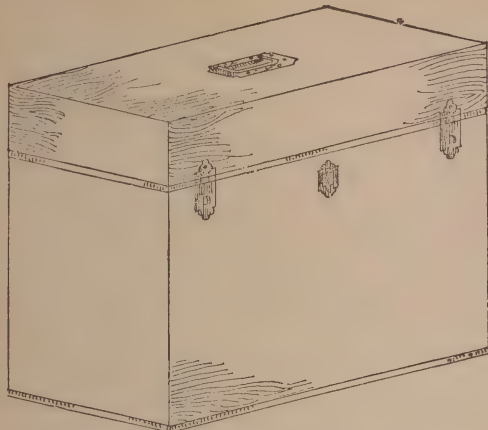


Fig. 1.—Strong Wooden Box shown in Perspective

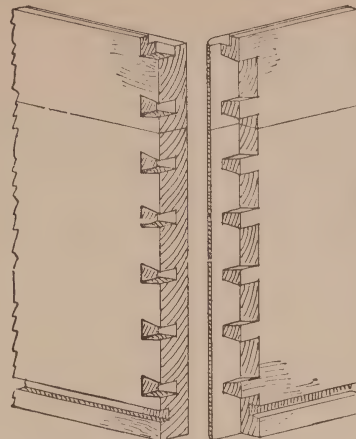


Fig. 3.—Secret Lap-dovetailing

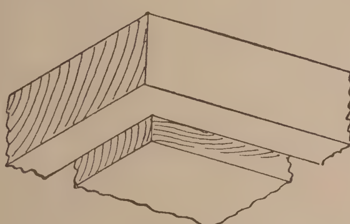


Fig. 6.—Portion of Top with Grooves to receive Tongues

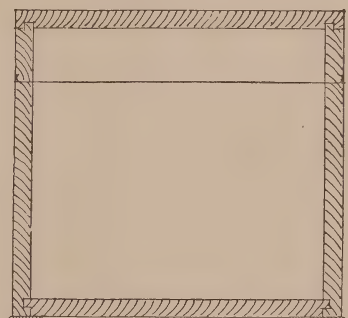


Fig. 2.—Longitudinal Section

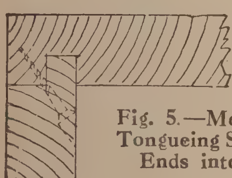


Fig. 5.—Method of Tongueing Sides and Ends into Top

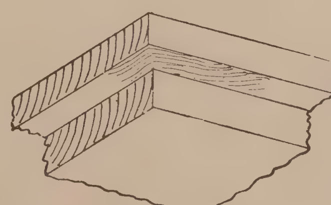


Fig. 7.—Tongue on Edges of Bottom

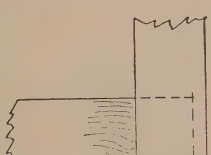


Fig. 4.—Plan of Corner

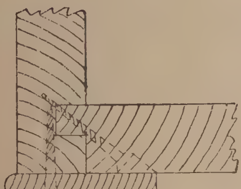


Fig. 8.—Joint between Bottom, Sides and Fillet

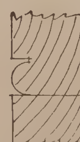


Fig. 9.—Joint between Rim of Lid and Sides

CLOTHES BOX FITTED WITH TRAYS

The clothes-box shown in front elevation in Fig. 10 is 3 ft. 6 in. long, 2 ft. 3 in. high, and 2 ft. from the back to the front. The material to be used may be good pine, red deal, or white deal, according to choice; red deal would, of course, stand the most wear. The boards for the sides, ends, bottom, and top should be about $\frac{7}{8}$ in. thick after being planed, and should be carefully jointed and ploughed and cross-tongued and glued. It is important when jointing up for a box not to have the glued joints of the front and back in the same plane as those of the ends. Fig. 10 shows the front formed of two pieces jointed, and Fig. 11 shows the end formed of three pieces. In a box of this description it is a good plan to make the rim of the lid and the sides and the ends all in one; then, when the top and bottom are fixed on, the part to form the rim is separated from the sides and ends by sawing along the lines as shown at A A (Fig. 10) and B B (Fig. 11). The sides and ends should be dovetailed together as shown. The lid being curved on the top, it will be necessary to form it of strips about 4 in. wide, which should be carefully jointed and ploughed and tongued together, as shown at D (Fig. 12).

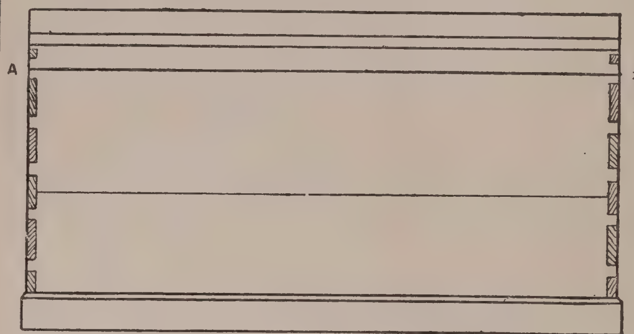


Fig. 10.—Front Elevation of Clothes Box

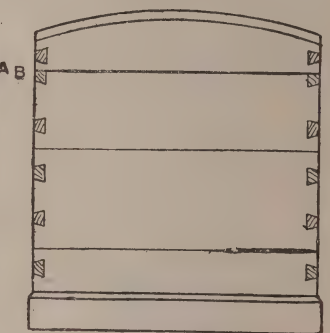


Fig. 11.—End Elevation of Clothes Box

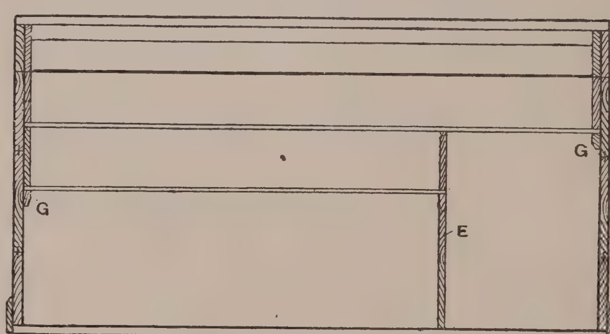


Fig. 13.—Longitudinal Section of Clothes Box

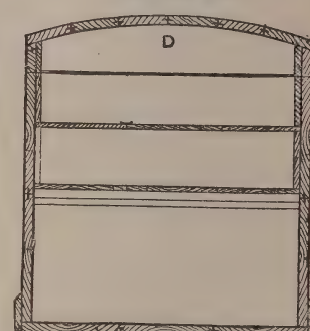


Fig. 12.—Cross Section of Clothes Box

The bottom can be formed of three boards jointed and tongued together. By referring to the illustrations it will be seen that the bottom is nailed direct to the lower edges of the sides and the ends;

it will be much stronger if glued to them before nailing. The plinth round the lower part of the box should be about $3\frac{1}{2}$ in. wide and $\frac{5}{8}$ in. thick, and chamfered as shown; it should be fixed with glue and a few small nails. The division E (Figs. 13 and 14) should be about $\frac{1}{2}$ in. or $\frac{5}{8}$ in. thick, and may be slightly housed into the sides. The trays should be made of wood about $\frac{5}{8}$ in. thick, the corners being dovetailed together, as shown in Figs. 14, 15 and 16; the bottoms of the trays may be thin boarding about $\frac{3}{8}$ in. thick, jointed together. For most purposes it will be better for the top tray to have a bottom formed of webbing interlaced, as shown in Fig. 16. Two fillets of wood about $1\frac{1}{4}$ in. by $\frac{3}{4}$ in. (G, Figs. 13 and 14) should be fixed to the ends to support the trays. Two small fillets will also be required to keep the

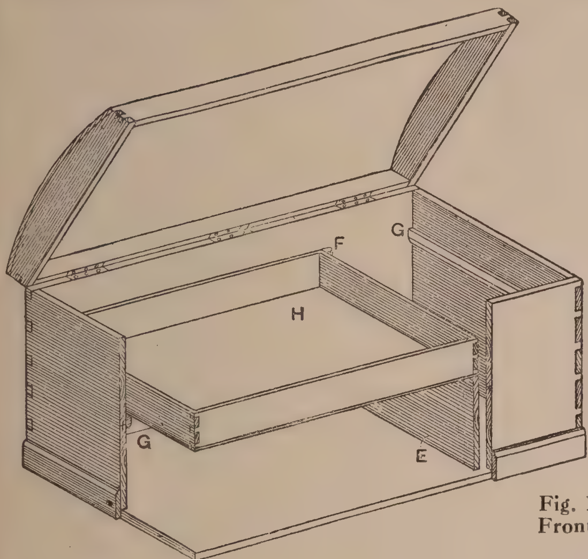


Fig. 14.—Clothes Box with Part of Front Cut Away, showing Interior

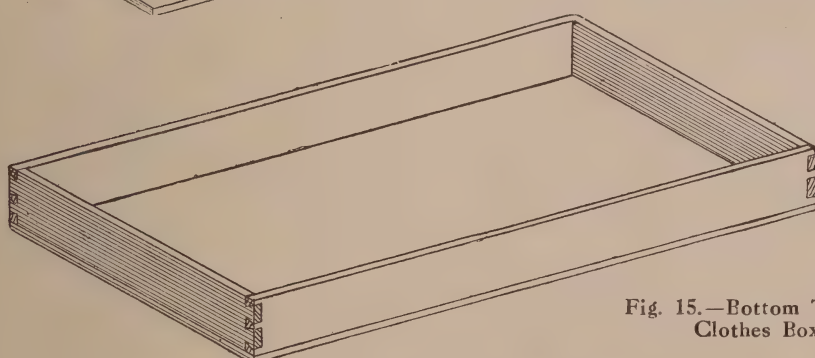


Fig. 15.—Bottom Tray of Clothes Box

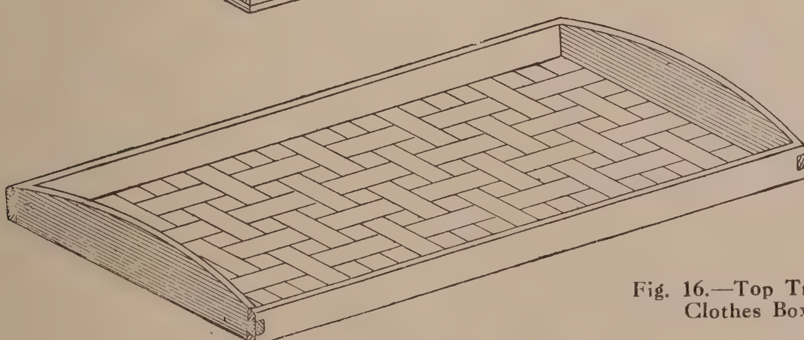


Fig. 16.—Top Tray of Clothes Box

lower tray H (Fig. 14) in position as shown at F (Fig. 14). The box should be fitted with three hinges and a lock.

BOX FOR TRANSPORT OF EGGS

A box for the special purpose of packing eggs for transit is shown in Figs. 17 and 18. It will be necessary to construct it strongly in order to withstand the rough usage it is likely to receive.

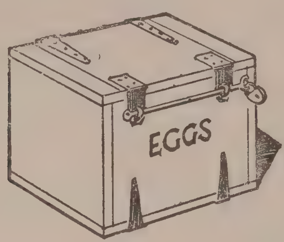


Fig. 17.—Egg Box, Closed, shown in Perspective

The chief sizes for the box shown are, length 1 ft. 4 in., breadth 1 ft., and height 1 ft. The thickness of the wood for the bottom, sides, ends, and lid should be about $\frac{3}{4}$ in. finished, for the sides and ends of trays $\frac{3}{8}$ in. finished, and for the divisions and bottom $\frac{1}{4}$ in. finished. A plan of the box, showing an egg-tray in position, is shown by Fig. 19.

The ends and back are dovetailed together, as shown in Fig. 22, and the bottom should be strongly screwed to the under edges of these. It will be seen that the lid and front are clamped (Fig. 20), which will be found to greatly strengthen these parts. Of course, if desired, the front could be dovetailed to the ends; but it will give more ready access to the trays and facilitate their removal if the front is made to drop as in Fig. 18, the particular kind of strap hinges required being clearly shown. Fig. 21 shows the method of fixing the hinges for the front and lid so as to allow of their tight fitting when closed. For fastening the box, a good method is shown in Fig. 17, two hinged staples with eyes and flange plates being screwed to the front. The eyes have holes sufficiently large to allow of an iron rod passing through. The rod has a head or ring at one end and an eye at the other, the latter for fastening by a padlock as shown. The sides and ends of the trays should be notched or cogged together, as indicated in Fig. 23. The sides and ends can be grooved to receive the ends of the divisions; but this is hardly necessary. Where the divisions cross each other they should be halved together, as shown in Fig. 24. The joints can be glued together, and further secured with a few sprigs. The bottom can then be nailed on to the edges of the sides and ends.

Each division can be lined with felt or straw, and a layer of felt between each tray would be an advantage. For lightness, the bottoms and divisions of the trays could be of three-ply wood. If exceptionally hard wear is anticipated, the angles might be protected with metal corners screwed on, and a strong metal handle would be useful. The box should be clearly marked " EGGS " in order to ensure careful handling.

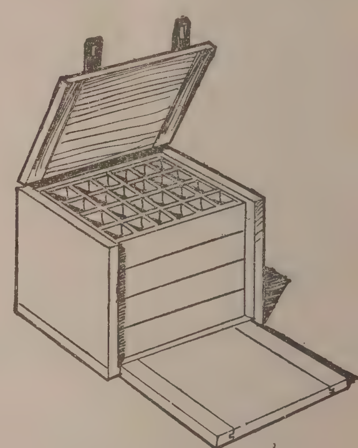


Fig. 18.—Egg Box, Open

DONATION BOX

A suitable form of donation box is shown by the photograph (Fig. 25) on page 460. The door forms a convenient shelf with sides when open, so that the coins cannot roll out, and can be counted whilst being

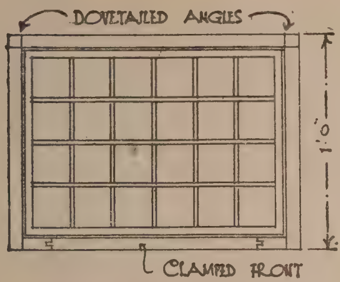


Fig. 19.—Plan of Egg Box, showing Tray

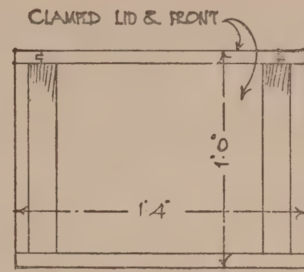


Fig 20.—Front Elevation

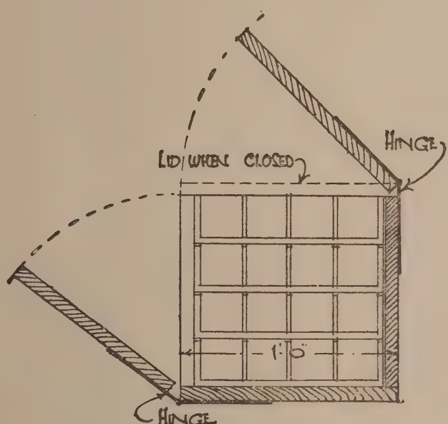


Fig. 21.

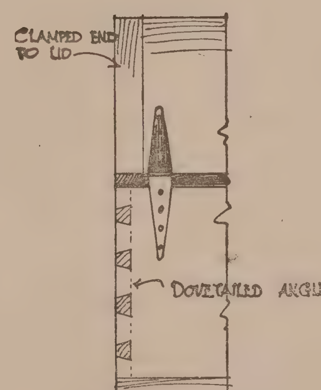


Fig. 22.—Part Back Elevation

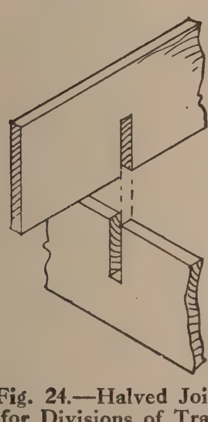


Fig. 24.—Halved Joint for Divisions of Tray

Fig. 21.—Section showing Trays and Method of Hinging Front and Lid

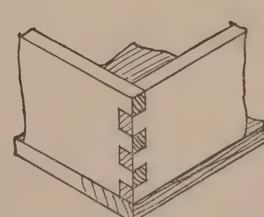


Fig. 23.—Angle of Tray

removed (*see* Fig. 26). The box is to be fixed to wood panelling with four screws through the back. The construction will be understood from Fig. 27.

The top, bottom and sides are of $\frac{1}{2}$ in. thick wood, strongly dovetailed together,

Fig. 25.—Photograph of Donation Box, Closed

Fig. 26.—Photograph of Donation Box, Open

and they are rebated at the back edge to receive the back panel of $\frac{3}{8}$-in. stuff in flush, which is glued and secured with screws. The door also is of $\frac{1}{2}$-in. stuff, with the shaped sides of $\frac{1}{4}$ in. thickness fixed on with glue and screws. The square end of these latter is bevelled (about $\frac{3}{4}$ in. on the inner side) to $\frac{1}{8}$ in. For hinging the door, two 2-in. brass butt hinges are used, put on flat and let in level, with the outside uppermost, therefore it is necessary to countersink the screw holes on that side. This is done to keep the inside quite level. It should be neatly fitted so as to have no visible space at the hinged joint, and to ensure against any slight shrinkage which might occur to make a space through which a very thin coin might escape. The bottom and inside of door is covered with leather glued on. This also serves to cover the hinges. A stop-slip is screwed under the top for the door to shut against, and a

Fig. 27.—Cross Section of Box showing Construction

piece of leather is put between and just under the slot to send the coins to the back of the box. The size of the slot is to take easily a 5s. piece.

In cleaning up the box for polishing, all the outside corners should be slightly rounded, and the wood then oiled over and french polished in the usual way.

LETTER BOX FOR DOOR

Most entrance doors are furnished with slots through which letters can be slipped, but it is not invariably that a receptacle is placed to receive them, and even when this is the case it is not always particularly easy to extract the contents from the box.

This objection, however, will not apply to the letter box here shown, the whole front of which slides up, leaving the interior fully exposed. A general view of the box is shown in Fig. 28. Front and side elevations are shown in Figs. 29 and 30. It can be of any desired size, although as drawn and figured it is likely to meet the average requirements. The material of which it is constructed is quite optional.

The chief point is that, as on most ordinary doors the letter box would unavoidably come partially over some of the panels, either these must have pieces planted on them in order to bring them out to a surface flush with that of the framing, or alternatively the two sides and bottom must be cut to the requisite outline at the back in order to come close up to the surfaces of the framing, mouldings and panels, as at A A (Fig. 30). The whole work can suitably be made out of stuff $\frac{1}{4}$ in. thick, and a beginning had better be made with two side pieces cut to the contour in Fig. 30, measuring about $2\frac{7}{8}$ in. in width at the top, and increasing as necessary in order to meet the panels (if any), as at A A (Fig. 30). The sides are kept apart by a top piece B (Fig. 30) $2\frac{1}{2}$ in. wide, and a bottom piece C $2\frac{7}{8}$ in. wide, plus whatever is found necessary to fit close up to the sunk panel face. These pieces would be 6 in. or a little more in length according to the slot in the door, and when their positions have been set out on the sides a small groove should be worked along each of the latter, $\frac{3}{16}$ in. wide, $\frac{1}{8}$ in. deep, and $\frac{3}{16}$ in. back from the front edges of the sides. These grooves are required to begin at the upper face of the bottom piece C (Fig. 30), and continue right up.

The door may next be fitted in these grooves (*see* Fig. 31), and is intended to consist of $\frac{1}{4}$-in. stuff $11\frac{3}{4}$ in. long and $6\frac{1}{4}$ in. wide, having a flat bevel about $\frac{3}{4}$ in. wide taken off it on all edges, thus reducing their thickness to $\frac{1}{8}$ in. A diamond-shaped opening can then be cut, and its edges slightly bevelled and filled in with a piece of glass or celluloid. Immediately below the diamond a wood stop should be planted on the back in order to strike against the top, and so prevent the door coming completely out of the grooves. A small knob or handle will complete the box, which can be stained or painted to match the door for which it is intended.

Fig. 32 shows a method of forming the

Fig. 28.—Letter Box shown in Perspective

grooves with two neat little fillets planted on the sides, thus obviating the need for ploughing the latter; while should any trouble be found in attaching the box to the door it may be useful to employ pieces, as at D (Fig. 33), measuring $\frac{3}{4}$ in. across. Another sample of a letter box was given in the section dealing with elementary examples.

TRAVELLING TRUNK

Fig. 34 is a general view of a strong travelling trunk made of wood. Fig. 35 is a front elevation. The following are the main particulars of its construction.

Useful sizes are given on the drawings, but, of course, these may be varied to meet requirements.

The necessary boarding, $\frac{3}{4}$ in. to 1 in. thick (according to strength required), having been obtained and cut to length for the sides, ends, bottom and top, it should arrange the boards to the top and bottom transversely, as shown at Figs. 36 and 37. The sides and ends should next be set out for lengths, and then the ends set out for dovetail pins. These should be arranged in the portion to form the rim of the lid, as shown at x x (Figs. 36 and 37).

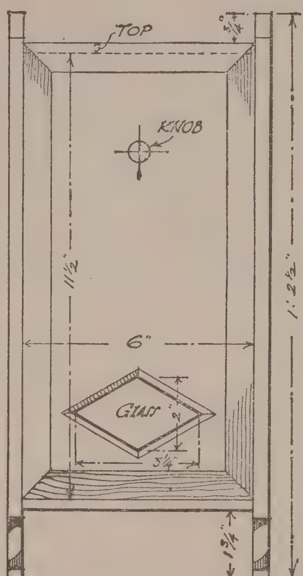


Fig. 29.—Front Elevation of Letter Box

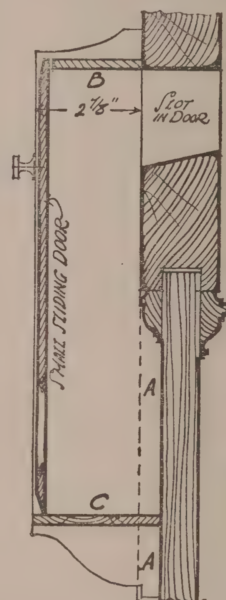


Fig. 30.—Section through Centre of Letter Box

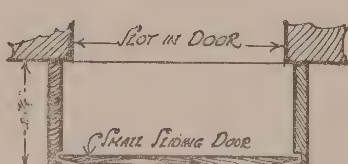


Fig. 31.—Plan near Top of Box

Fig. 32.—Method of Planting on Fillets to Form Alternative Groove for Sliding Door

Fig. 33.—Suggestion for Fixing Box to Door

be jointed and ploughed for tongues. Instead of this, machine-prepared grooved-and-tongued floor boarding of good quality and well seasoned will answer the purpose admirably. The joints should be glued and cramped close together until the glue is dry. Care should be taken not to have the joints in the sides and ends in the same plane. It is a stronger method to

After these are sawn and the waste cut out, the pins should be placed on the sides, and the sockets marked out from them. A strong form of dovetail is shown at Fig. 38. Fig. 39 shows the box pin joint, which is rather easier to make, but is not so strong as dovetailing. When ready, the joints should be glued and further secured with a few nails. Then

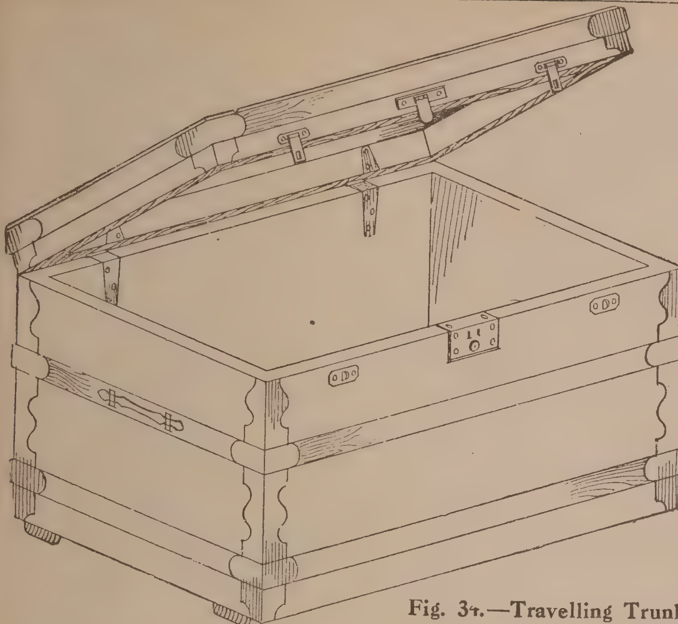


Fig. 34.—Travelling Trunk shown in Perspective

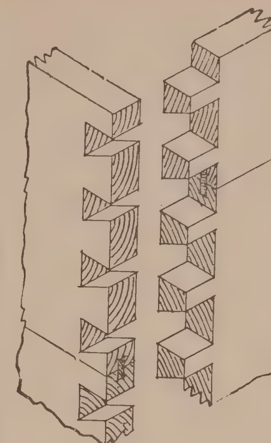


Fig. 38.—Dovetail Joint for Corners of Trunk

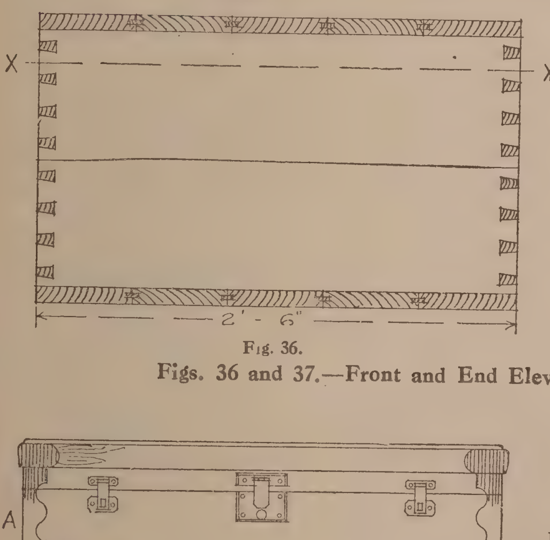


Fig. 36.

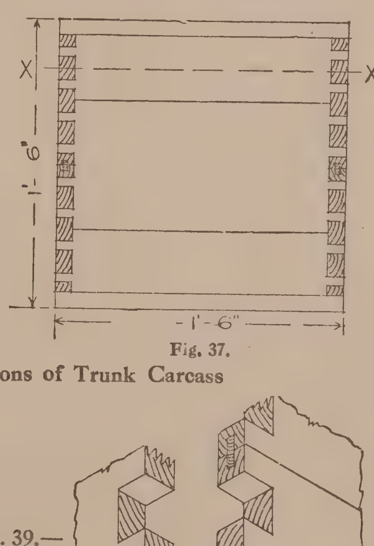


Fig. 37.

Figs. 36 and 37.—Front and End Elevations of Trunk Carcass

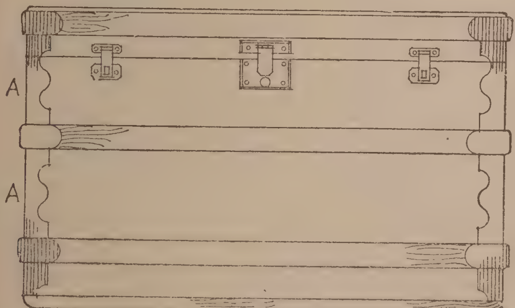


Fig. 35.—Front Elevation of Travelling Trunk

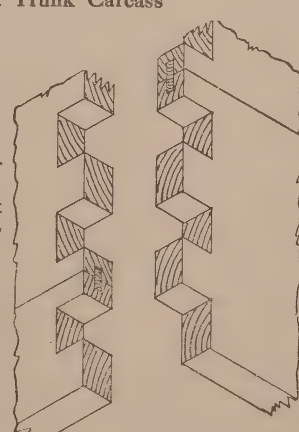


Fig. 39.—Alternative Joint for Corners of Trunk

the top and bottom can be glued and nailed to the sides and ends, and planed flush where necessary. The part forming the lid should next be separated by cutting along the lines x x (Figs. 36 and 37).

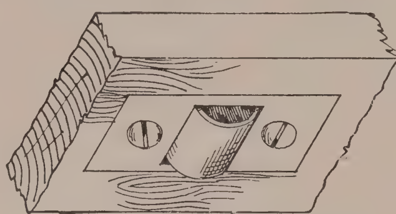


Fig. 40.—Roller Let into Batten

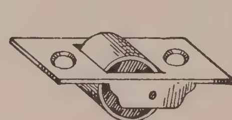


Fig. 41.—Roller

The whole of the outside can be covered with american cloth or a stout close-woven canvas; in each case the material must be stuck down firmly and evenly to the wood with strong glue.

Two or three battens about $\frac{3}{4}$ in. by $2\frac{1}{2}$ in. should be fixed on to the bottom of the box, preferably with screws, and an iron roller should be let in near each end, so that its plate is flush with the surface of the batten, as shown at Fig. 40. Fig. 41 shows the form of roller used. Some strips of ash or oak about $\frac{5}{8}$ in. by $1\frac{3}{4}$ in. should be fixed to the sides and ends as shown. These may be secured with screws inserted from the inside, if desired. Some sheet-iron plate or mild steel plate, about $\frac{1}{16}$ in. thick, should be cut into strips, 3 in. to 4 in. wide, and bent down the centre at right angles. The outer edge may be straight or shaped, as shown at A (Fig. 35). Holes should next be punched and countersunk, so that the plates can be fixed to the angles of the box with screws. Care should be taken to file off all the outer arrises of these iron angle bindings. The bindings of the fillets need only be slightly narrower than the fillets. The lid should be fixed with a pair of box hinges, as shown in Fig. 34. A suitable lock, and a staple fastening at each end, should also be fixed.

If the box is covered with strong canvas, this may be painted brown, or any other colour desired, and a coat of varnish will improve the appearance of the battens. The ironwork should be japanned or coated with an enamel. The interior of the trunk can be fitted with a movable tray, etc., as necessary. To make the box dust-proof, a fillet should be nailed round the inside, so as to project into the rim of the lid.

CLOTHES BOX WITH SECRET DRAWER

Fig. 42 shows a clothes chest which is divided into three parts by means of two trays, so as to keep the various clothes separate. The bottom space is intended

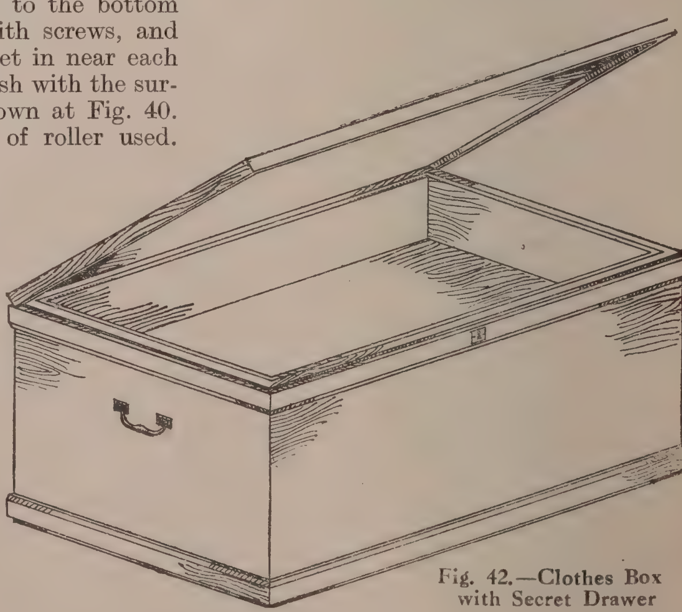


Fig. 42.—Clothes Box with Secret Drawer

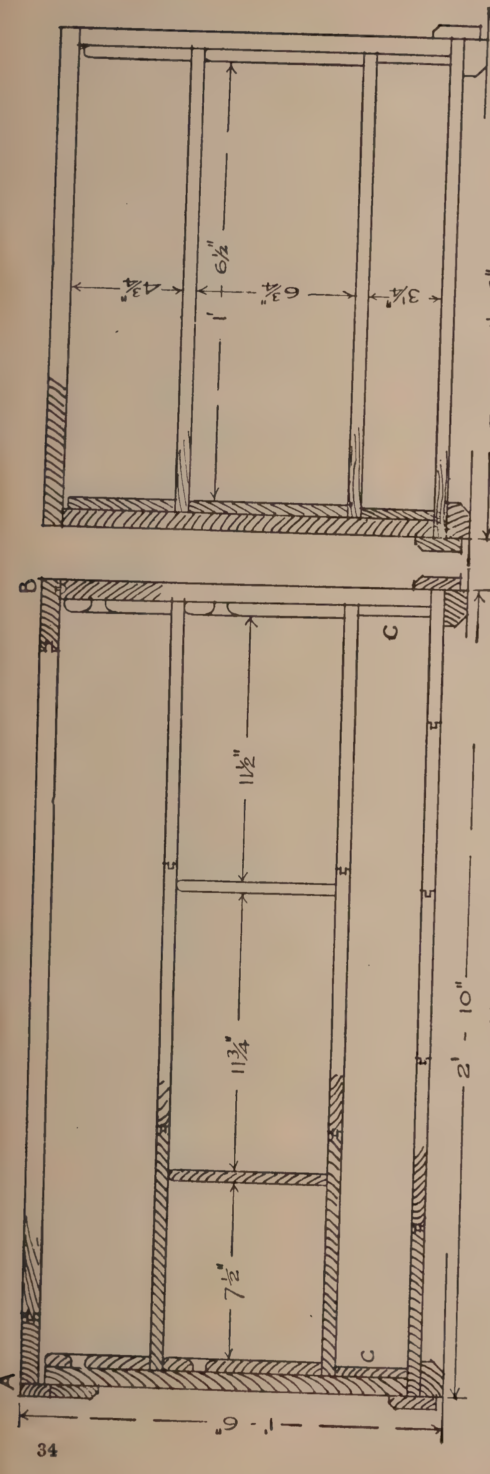


Fig. 44.

Fig. 43.

Figs. 43 and 44.—Longitudinal and Cross Sections of Clothes Box with Secret Drawer

for trousers; the middle one (which is divided into three) is for shirts and collars; and the top one for coats. Longitudinal and cross sections are shown in Figs. 43 and 44.

The chest is made from $\frac{3}{4}$-in. yellow pine, dovetailed together, with a $\frac{1}{2}$-in. bottom nailed on, and $1\frac{1}{2}$-in. by 1-in. pieces screwed to the bottom to keep it off the floor. The end and side wood at the bottom is covered by a base, which is mitred at the corners and nailed on. The lid is made of $\frac{3}{4}$-in. wood, with 3-in. cross-ends mortised and tenoned to it. There are two arrangements shown for the lid: A (Fig. 43) shows an arrangement with one facing nailed to the lid and resting on the other, which is nailed to the box, and kept down $\frac{1}{2}$ in. from the top edge; B shows a throating cut out of the top edge of the chest, and a small bead fastened to the lid.

The trays are dovetailed together, and a grip hole is cut out at each end, and nicely rounded. The tray bottoms, which are feathered and grooved together, having the grain running the short way are screwed to the under side of the trays. Small pieces are put in at the bottom of the box to carry the bottom tray, the top tray resting on the bottom one. The top edges of the trays are rounded, and should be mitred at the corners, the divisions being mitred to the middle of the round. The base is only shown on one part of Fig. 43, but it should be carried all round.

If desired, a secret drawer can be fixed to the chest as described below. Fig. 45 is a vertical section, and Fig. 46 a horizontal section taken just below the underside level of the bottom C (Fig. 43).

The divisions A and B (Fig. 45) should be prepared with small flush beads as shown; this will hide the joint between the front of the drawer and the division. The divisions A and B and the sides of the till should

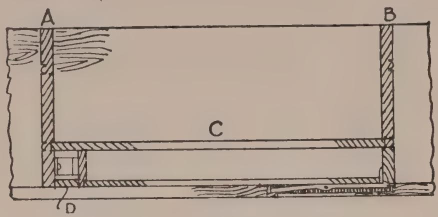


Fig. 45.

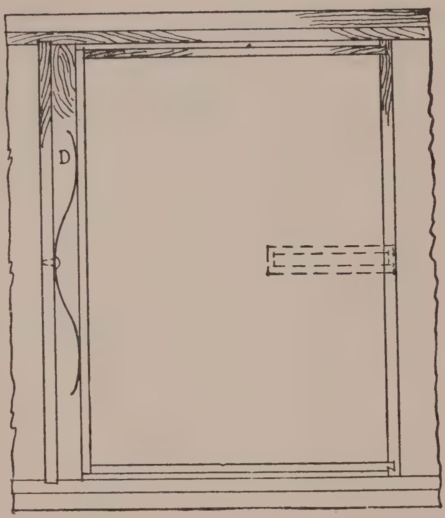


Fig. 46.

Figs. 45 and 46.—Vertical and Horizontal Sections of Secret Drawer

be grooved to receive the bottom C as indicated. The front of the drawer should be a good fit at each end up to the sides of the till. The sides of the drawer should be dovetail-grooved into the front, as shown in Figs. 46 and 47, the joints with the back being ordinary dovetails. It will be seen that the sides of the drawer are about ¼ in. away from the sides of the till; this will allow of the drawer coming out more easily, as the front can be placed a little obliquely while withdrawing it, and thus it will not bite against the sides of the till. The bottom of the drawer should be accurately fitted in rebates made in the front, sides, and back. A piece D (Figs. 45 and 46) should be fixed to the bottom of the till and fit just to the back of the drawer, so that the front of the latter is flush with the face of the division B. A piece of steel spring should be bent to shape and fixed with a screw (see Fig. 46); of course, the spring should be sufficiently

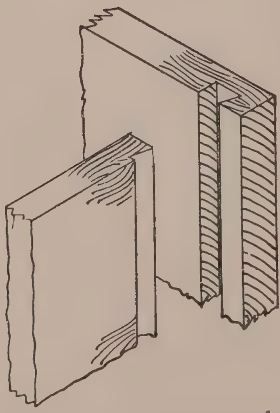


Fig. 47.—Dovetail Housing for Drawers

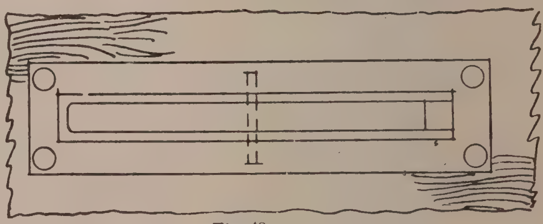
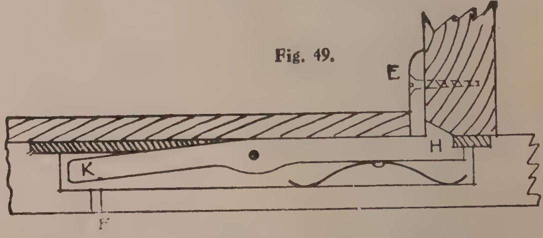


Fig. 48.

Fig. 49.



Figs. 48 and 49.—Plan and Section of Drawer Fasteners

strong to push the drawer forward 1 in. or more on the fastening being released.

The fastening is shown in plan by Fig. 48 and in section by Fig. 49. A small hole is made in the bottom of the till as indicated at F. This hole only need be large enough to admit the point of a penknife or anything similar, but, if desired, it may be sufficiently large to admit the tip of the finger. On pushing up the end of the lever at K, the end H is lowered and detached from the brass plate E (screwed to the inside of the front of the drawer), and immediately the spring at the back pushes the drawer forwards. To close the drawer, it is simply pushed so that the brass plate E, coming in contact with the catch H, pushes it down; then H, of course, rises and clips E as shown. It will be seen that the catch and lever are kept in position by a spring, and the end H is prevented from being pushed too high by the spring, as the brass plate catches it.

Tool Chests

PORTABLE TOOL BOXES

TOOL CHESTS are an obvious convenience, and are usually made by the workmen in all trades for convenience in storing their tools.

The box (Fig. 1) should be large enough to hold the hand-saw and the panel-saw in the lid. A useful size is 2 ft. 7 in. long,

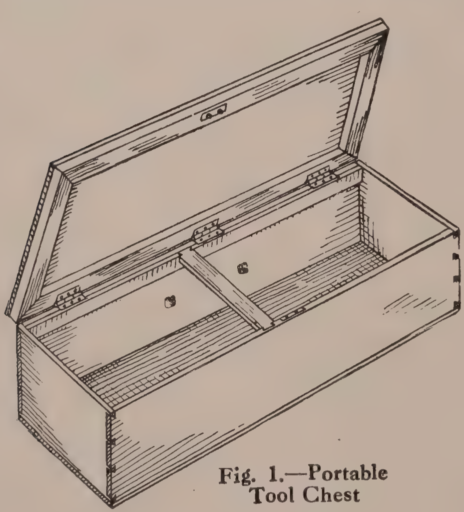


Fig. 1.—Portable Tool Chest

11 in. wide, and 7 in. deep, outside measurements. This is just large enough to take a 26-in. hand-saw and a 22-in. panel-saw. The box may be made a little narrower if the panel-saw is put with the rest of the tools in the body of the box. The sides, top, and bottom are made of $\frac{1}{2}$-in. stuff, preferably pine. The sides are dovetailed together, and the bottom then screwed on. Pieces $1\frac{1}{4}$ in. by 1 in. are screwed to the top to strengthen it, form a deep panel to hold the saws, and to afford good fastening for the hinges. The latter are three 3-in. brass butts. A strip $1\frac{1}{2}$ in. by $\frac{3}{8}$ in. is screwed to the inside top edge of the back to receive the hinges and to strengthen the back.

A handle is bolted to the back of the box for carrying purposes. To strengthen the back and front whilst carrying, a $1\frac{1}{2}$-in. by $\frac{1}{2}$-in. strip is dovetailed to the top edge of the front side and to the strip at the top of the back. This strip is removable, and is only placed in position when the box is to be carried. The box is fitted with a reliable box lock. The saws are held in the lid panel by cleats for the blade ends, and by wooden turn-buttons (about 2 in. by $\frac{3}{4}$ in.) through the holes in the handles. The box should be given two coats of black paint, with the initials of the owner lettered in white on the top of the lid.

Alternative Design.—Fig. 2 is a photograph of an alternative design of box.

The framework of this may be $\frac{5}{8}$-in. cypress dovetailed at the corners, a suitable size being $34\frac{1}{2}$ in. by 16 in., one half being 3 in. deep, the other 2 in. A rebate joint as shown enlarged in Fig. 5 joins the two parts, and prevents strain on the hinges when the case is closed. The tongue on the wider half measures $\frac{1}{4}$ in. by $\frac{1}{4}$ in., and a $\frac{3}{16}$-in. bead is also wrought on this edge to improve the appearance of the job.

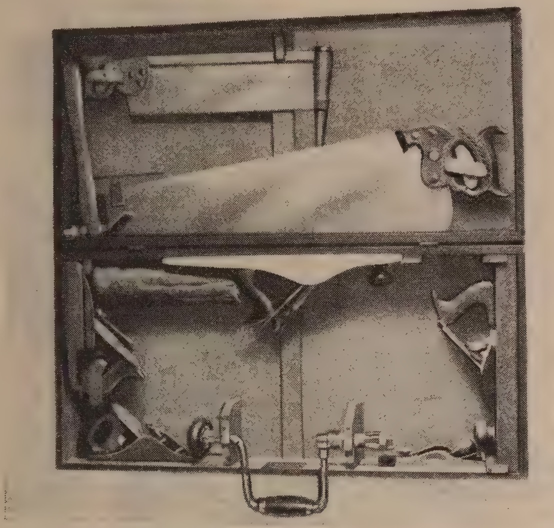


Fig. 2.—Alternative Form of Portable Tool-box

The sides of the framework are covered in with $\frac{3}{16}$-in. plywood. The bar across the middle of each side is a strengthening member, which should only be omitted if the sides are of thicker stuff, say $\frac{1}{4}$ in. The sides are secured by gluing and screwing, $\frac{3}{4}$-in. brass button-head screws at 3-in. spacing being used.

As the photograph shows (Fig. 2), the brace is utilised as a carrying handle, two slots being cut in the deeper side of the chest to accommodate it, while the two brackets shown transmit the weight of the chest solidly to the chuck-neck and handle-neck respectively. The methods of accommodating the planes and saws will be obvious from the illustrations, Figs. 2

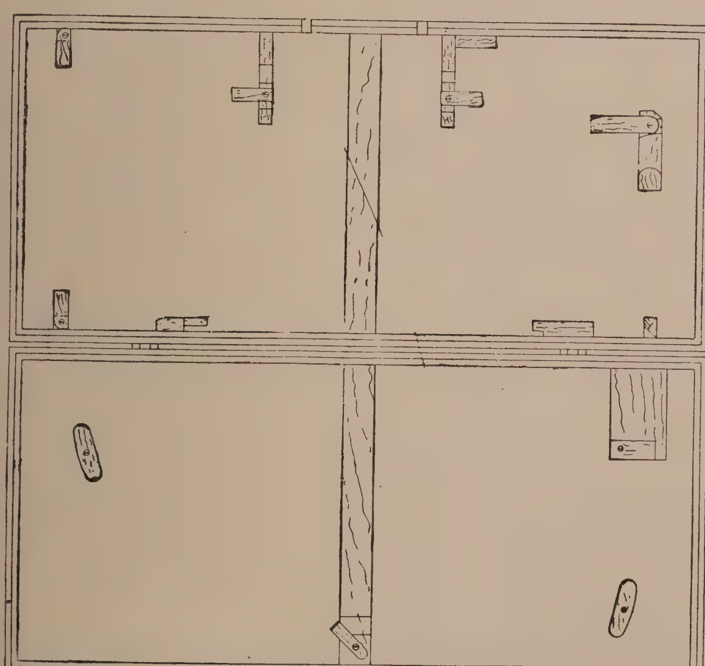


Fig. 3.—Plan of Tool-box, Open

Fig. 4.—Cross-section of Tool-box, Closed

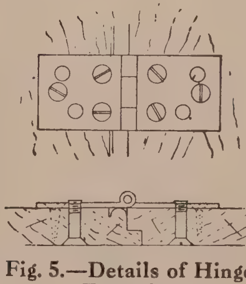


Fig. 5.—Details of Hinge Fastening

and 3. Attention may be drawn to the position of the square in the corner behind the rip-saw, the blade fitting into a saw-cut in the block shown. The handle of the smoothing plane fits into a shaped block lined with baize, wherein it is held by the turnbutton. All the planes, in fact, are secured by blocks appropriately shaped to hold one end, suitable turn-buttons fastening the other. All blocks attached to the three-ply sides are secured by screwing through from the outside plus gluing. Fig. 4 shows a cross-section of the box.

No special provision is made in building

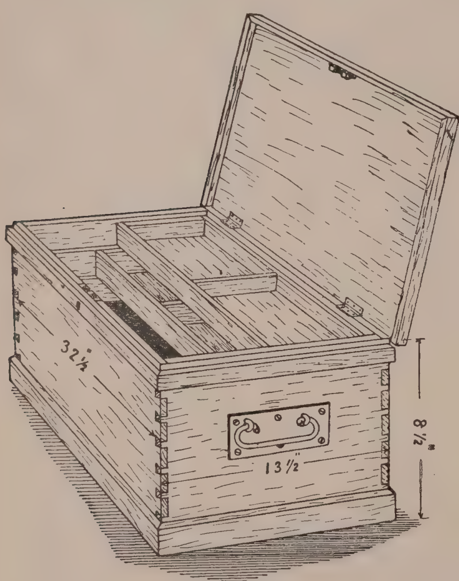


Fig. 6.—Patternmakers' Tool-chest

the chest for the smaller odd tools, as the actual selection of these carried naturally varies very much with the nature of the work to be done, and therefore the construction of fitments likely to suit every possible grouping is impossible. The case is fitted with a lock and key; but for ordinary securing, a couple of strong hooks and eyes are fitted. The hinges for strength's sake are backflaps, and are secured as shown in Fig. 5. In addition to the ordinary wood-screws attaching the hinges, two $\frac{3}{16}$-in. Whitworth countersunk screws are tapped through each flap from the inside, and the projecting points riveted over, thus rendering it impossible for the contents of the chest to be got at by tampering with the hinges. For greater protection against hard usage, iron corner-plates should be screwed to the eight corners of the chest.

No dimensions other than the external sizes have been given, as these will naturally differ according to the actual tool-carrying requirements of the individual maker.

PATTERNMAKERS' TOOL-CHEST

A tool-chest to hold patternmakers' tools is shown in Fig. 6.

The largest tool likely to require accommodation is the jack plane, for which a box 18 in. long would be sufficient. But if a hand-saw is included it would require to be not less than 31 in. inside measurement. A trying plane is large and could not be dispensed with. A tenon saw is continually wanted, and if kept in the box must be easy to get at. The box should be long enough to take the longest tool, and should be less in depth than it is in width. A depth of 10 in. and a width of 12 in. should be ample; in fact, the depth might be cut down to 8 in. and still leave room for all the tools a patternmaker requires, provided they are suitably arranged in the box. This, of course, means that the tools must be packed in on top of one another, and the lower ones be inaccessible until those above are removed.

A plain interior with no fittings of any kind is scarcely desirable even when it is important to cut down the size. A simple arrangement is to fit two sliding tills, as shown in the illustration, for small tools, including the paring tools, and reserve the body of the box for large ones. These tills can be lifted out or slid to the back or the front of the box as required, their width being half that of the box. The ledges on which they slide are nailed or screwed to the ends, the lower ones being an additional thickness on the upper, so that the lower till is about $\frac{1}{2}$ in. shorter

than the upper to allow of lifting out. The tills should not be very deep, or they will occupy too much of the interior space. A depth of 1½ in. for the top one and 2¼ in. for the other is sufficient. They can be dovetailed or simply nailed.

The body of the box itself should be dovetailed. Either hard or soft wood can be used as preferred. A suitable thickness for the box is about ⅝ in. Tills need not be more than ¼ in. to ⅜ in. thick. The sides and ends are prepared first, and are planed to thickness, width, and length. The length, both of sides and ends, will be the overall measurement if the corners are to be dovetailed; the width will be the inside measurement. Sometimes the sides are screwed or nailed temporarily face to face, while the edges and ends are planed and the dovetails marked and cut, as this is a little quicker than dealing with each piece separately. The ends are treated similarly except that the dovetail lines on them are usually transferred direct from the sides which they have to fit, each end in this case having its dovetails marked and cut separately. The dovetails may be measured and their angles marked with a bevel, or they may be simply divided and marked by freehand, the lengths, of course, which correspond with the thickness of the wood, being gauged on both sides of the pieces in all cases. If this method is adopted each joint, at the time the transference of the dovetail lines to the end pieces is made, must have a number or other mark pencilled on each piece to show the position for fitting together.

When the sides and ends are fitted they are glued and nailed, and then the bottom is nailed on. It is important at this stage to see that the dovetailed frame is square, for the nailing on of the bottom fixes it unalterably. A piece for the cover is prepared similar in length and width to the bottom. There is the choice, however, of making the cover longer and putting its border strip across the under surface instead of on the end grain as illustrated.

Plinths are nailed round the bottom and top edges as shown, those at the top being ½ in. or so below the top edge, and the border round the cover coming down to meet them when the cover is closed. Those at the bottom may be protected and strengthened by corner pieces of sheet-iron screwed on. The bottom, and the cover also, may be stiffened with battens across the grain. The grain of the bottom need not necessarily run lengthwise, as that of the cover and sides does. It may be composed of a number of short pieces with grain the other way.

Sometimes the under surface of the cover does not bear directly on the top edge of the box, but has a depth of 1 in. or more, so that saws and other suitable tools can be attached to the inside of the cover, and allow the latter to be closed with the box filled level with its top edge with other articles. The same effect can be produced by keeping the top till 1 in. below the top edge of the box and not packing tools above that mark. A plain flat cover, with the usual border, can then be used and still have fittings for the attachment of tools; but attachment in this way is scarcely convenient for tools in constant use, and is a matter of taste rather than convenience for tools seldom used.

When the box has to be packed for travelling, plenty of cotton waste or paper or other suitable material should be used to keep the tools immovable, as it must not be assumed that the box will always be handled carefully and kept the right side up. The cover also should be screwed down instead of merely locked.

WOODWORKERS' TOOL CHEST

In constructing the tool chest shown in perspective by Fig. 7, and cross-section by Fig. 8, the length must be sufficient to accommodate a rip-saw. This will make the chest 2 ft. 9 in. long internally, and if it is made 1 ft. 8 in. wide by 1 ft. 9 in. deep, it will be found convenient for all purposes.

The material for the outside case should be good white deal or yellow pine, and as the chest may have to stand some rough usage, it should not be less than 1 in. thick. In gluing up the front, back, and ends to

obtain the necessary width the joints should be tongued or dowelled, the former being the better method. In dovetailing the chest together, the number of tails should not be stinted, and they should not be more than $1\frac{1}{2}$ in. apart, as in Fig. 9, as the closer they are the stronger will the chest be. Care should be taken that the joints (*see* Fig. 10) do not come immediately opposite those in the ends.

The plinths run all round the chest, and should be 6 in. and $2\frac{1}{2}$ in. wide and 1 in. thick, respectively, with one edge finished with a plain bevel. The plinths, or skirting, can be mitred at the corners, but it will be stronger to dovetail them. The top plinth, or rib under the lid, must be kept down about $\frac{3}{4}$ in. from the top of the chest, so as to form a rebate for the lid to shut on. The bottom should be 1 in. thick, tongued and grooved, and nailed on crosswise; that is, the grain to run from the front to the back of the chest.

Fig. 7.—Woodworkers' Tool Chest

The lid should be made from the same kind and thickness of material as the chest, with the joints tongued and grooved, and the ends clamped (Figs. 10 and 12); that is, the lid should be tenoned, and the clamp mortised through and glued and wedged. The lid should be fitted so as to overhang the chest all round about $\frac{1}{16}$ in., and be hung with a pair of strong brass butts, and the lock (which should be a spring one, self-acting) put on, after which the rim of the lid can be mitred together at the corners, and grooved in the front and the ends (*see* Figs. 13 and 14).

For the inside of the chest good yellow deal or pine is recommended, which can be finished by staining. If desired, a more fancy wood can be used. As shown in Figs. 15, 16, and 17, the chest is divided in width into three parts; A, for bead-planes, plough, etc., this is 7 in. wide, and is covered by the sliding tills; B, for miscellaneous tools, best planes, or anything which is not in every-day use; and C (which is $3\frac{1}{2}$ in. wide inside) is the saw till. These compartments are divided by the two partitions shown, that between A and B being 9 in. high, and that between B and C 1 ft. 2 in. The three tills G, H, and J slide to and fro to give access to the compartments beneath, and when in place at the back of the chest, form a covering for compartment A; a sliding ledge D beneath the tills, when pulled out as shown by dotted lines, covers compartment B. The bench-planes, etc., can be packed away on the sliding board between the tills and the highest partition.

Fig. 16 shows one end of the chest with the cleats fixed, between which the partitions fit, and which are about 1 in. wide by $\frac{1}{2}$ in. thick. Those which hold the partition between B and C should be fixed

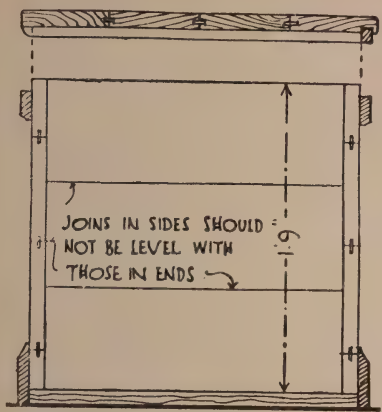


Fig. 8.—Cross-section of Tool-chest

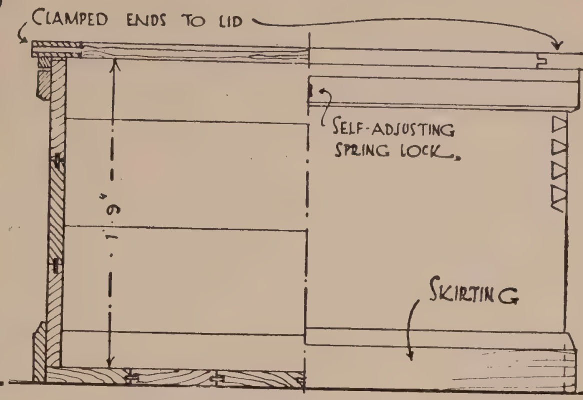


Fig. 10.—Half Longitudinal Section and Front Elevation of Tool-chest

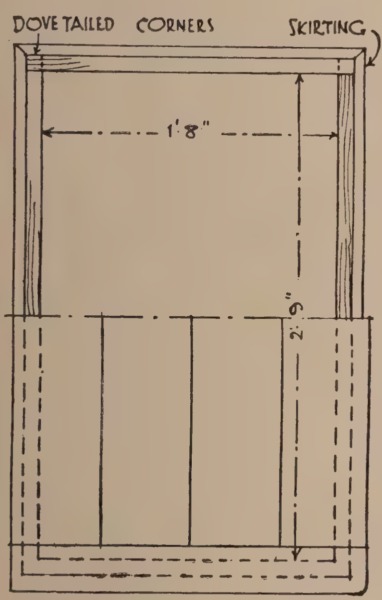


Fig. 11.—Half Plans of Lid and Chest

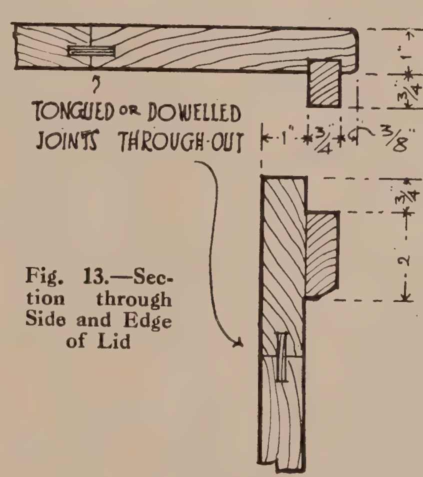


Fig. 13.—Section through Side and Edge of Lid

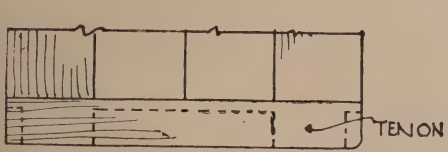


Fig. 12.—Clamped End of Lid

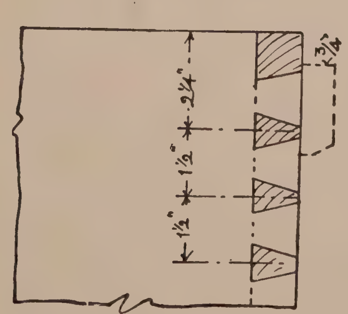


Fig. 9.—Dovetailing Sides Together

first, $\frac{1}{2}$ in. apart, the one nearest the back of the chest reaching nearly to the top, the other, nearest the front, stopping at the same height as the partition. The back partitions having been placed in position, the horizontal cleats can be fixed, the top edges of which must be $9\frac{1}{2}$ in. from the bottom of the chest, and they must run from the back of the chest to the long upright cleat, as shown in Figs. 16 and 19. On these the sliding ledge D works, which is 9 in. by $\frac{3}{4}$ in., clamped at the ends,

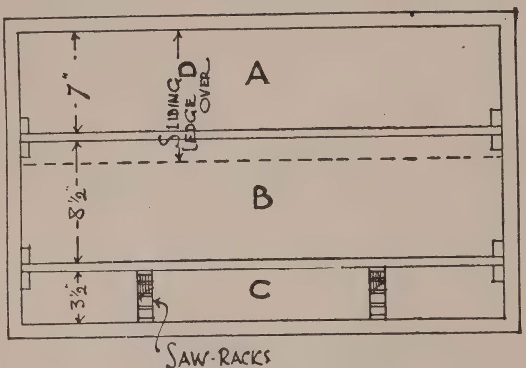


Fig. 15.—Horizontal Section through Lower Part of Chest

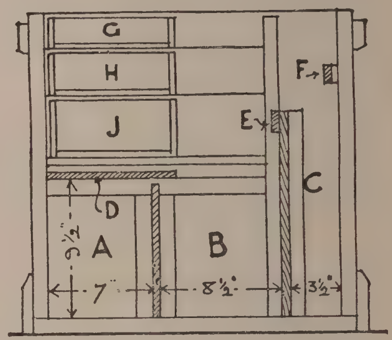


Fig. 16.—Cross-section showing Tills, etc.

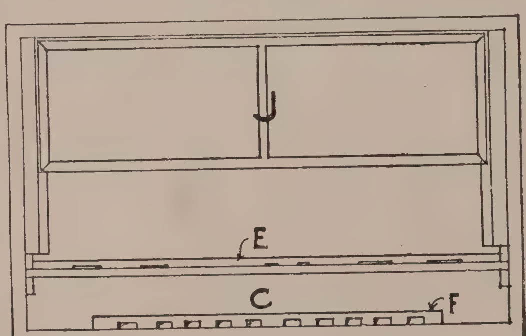


Fig. 17.—Horizontal Section through Upper Part of Chest

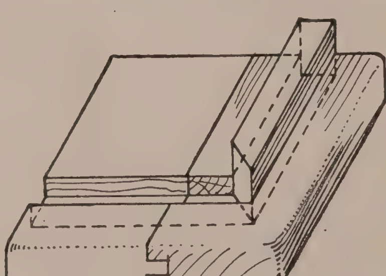


Fig. 14.—Corner of Lid Inverted showing Housed and Mitred Fillet

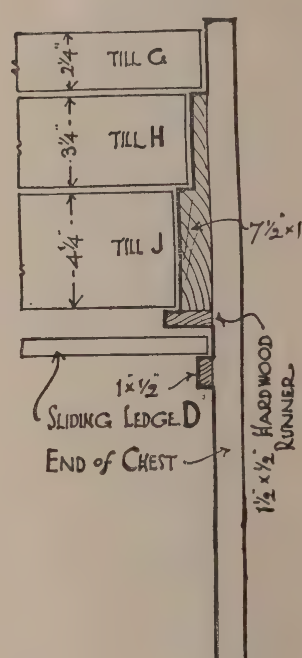


Fig. 18.—Section through Runners

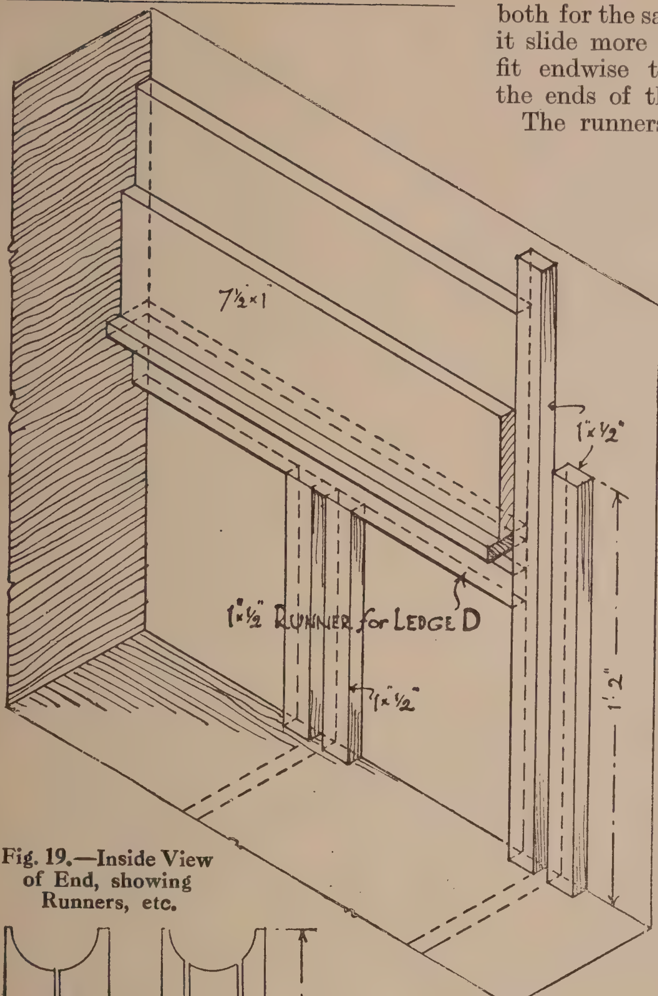


Fig. 19.—Inside View of End, showing Runners, etc.

both for the sake of strength and to make it slide more easily. It must be a good fit endwise to avoid jamming against the ends of the chest.

The runners for the tills (*see* Figs. 18 and 19) must be long enough to reach from the back of the chest to the long upright cleat, and should be of hardwood. The principal piece, which forms the runners for the two top tills, is $7\frac{1}{2}$ in. wide by 1 in. thick, rebated to half its thickness for a depth of $3\frac{1}{4}$ in., and having a piece of hardwood $1\frac{1}{2}$ in. by $\frac{1}{2}$ in., screwed on to the thick edge, forming the runner for the bottom till. These can be fixed in position, one on each end of the chest, leaving about $\frac{1}{8}$-in. clearance between the bottoms and the top of the sliding ledge D. The partition between compartments B and C can be made and fitted between the cleats, having along its upper side a strip of $1\frac{1}{2}$-in. by $\frac{1}{2}$-in.

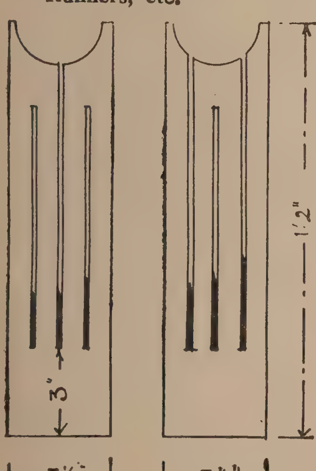


Fig. 21. Fig. 22.

Figs. 21 and 22.—Details of Saw Racks

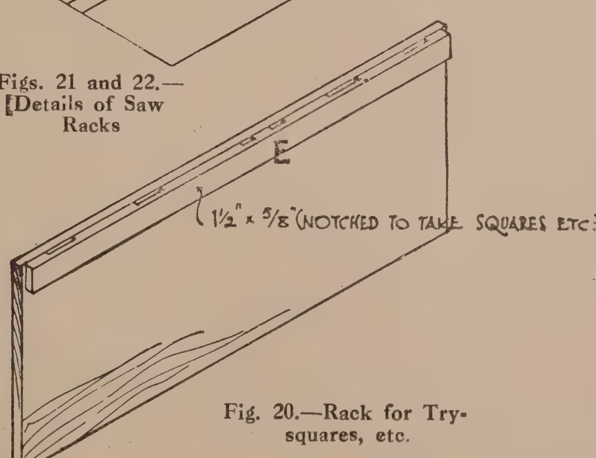


Fig. 20.—Rack for Try-squares, etc.

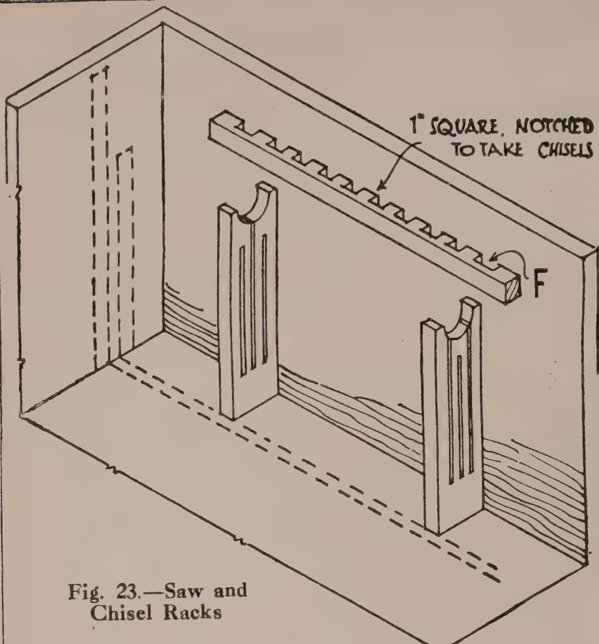


Fig. 23.—Saw and Chisel Racks

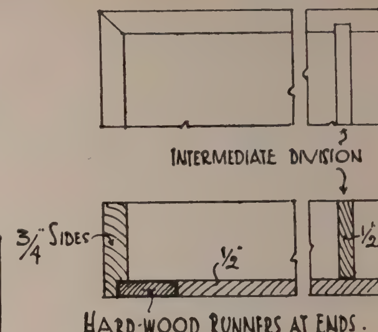


Fig. 24.

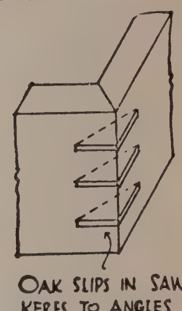


Fig. 25.

Figs. 24 and 25.—Details of Till Construction

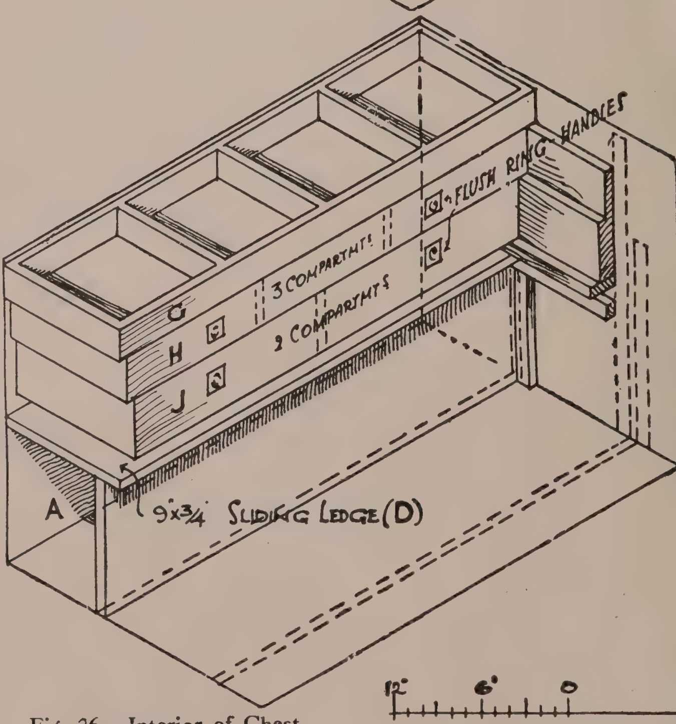


Fig. 26.—Interior of Chest showing Tills, etc.

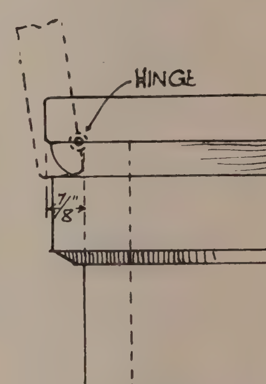
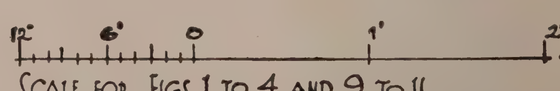


Fig. 27.—Method of Hinging Lid of Chest



deal, cut to fit between the cleats on each end of the chest, fixed level with the top edge, on the side nearest the front of the chest, and notched about $\frac{1}{8}$ in. at intervals. The slots thus formed can be used for squares, etc., the stocks resting on top of the partition and the blades hanging down inside the saw till (*see* Fig. 20).

The saw-racks (Figs. 21, 22, and 23) are 1 ft. 2 in. long, $3\frac{1}{2}$ in. wide, and 1 in. thick, shaped at the top ends, and with three slots made in each. The middle slot, in Fig. 21, runs from the top to within 3 in. of the bottom, the remainder stopping the same distance from the bottom, and about $1\frac{1}{2}$ in. from the top. In the other (Fig. 22) the middle slot is stopped at both the top and the bottom, and the other cuts through at the top end. These two racks are fixed at about 8 in. from each end, by screwing through the horn at the top to the front of the chest, as shown in Fig. 23. The partition being then put into its place, screws can be put through it into each saw-rack, which will hold all in place. In placing the saws in the racks, the points are inserted in the closed slots, and the handle ends dropped into the open slots, one saw pointing one way and two the opposite.

A piece of hardwood, 2 ft. long and 1 in. square, with a series of notches cut into it wide enough to take the various chisels, etc., and with about $\frac{1}{2}$ in. of solid wood left between each, can be screwed to the front of the chest just above the top of the partition (leaving an equal space at each end to allow room for the hand to be inserted to remove the saws) to furnish a resting-place for the larger chisels, the handles being just inside the front of the chest, the blades hanging in the saw till (*see* F Fig. 23).

The three sliding tills are of the same width, namely, 9 in. outside, but vary in depth. They should be of $\frac{3}{4}$-in. stuff, with $\frac{1}{2}$-in. bottoms and divisions, the rims dovetailed together, or mitred, as in Figs. 24 and 25. The fronts and back should be rebated to receive the bottoms, the grain of which should run across the width of the tills. At each end the bottom should be of hardwood. The divisions should be trenched into the sides, forming in G, H, and J respectively two, three, and four compartments (*see* Fig. 26). One of the bottom divisions should be fitted up for the brace and bits, with racks for the bits fitted round the brace, by which means one division can be made to accommodate the former and a whole set of the latter. Other divisions can be fitted with racks for small chisels, gouges, gimlets, bradawls, and various other tools.

Turn-buttons to take the tenon and dovetail saws can be screwed to the underside of the lid, so that when it is closed they will be in position between the top till and the front of the chest. The sliding ledge D can be grasped underneath with the fingers when it is desired to draw it forward, and it should have a couple of thumb-holes cut in its top by which to push it back. Each till should have a pair of flush-rings inserted in the front, so that it can be pulled forward without touching the others.

Owing to the rib under the lid running round the box the method of hinging will be as shown in Fig. 27. A strong iron handle on each end of the chest will make it complete.

Work Benches

BENCH ATTACHMENTS FOR TABLES

A SIMPLE contrivance which can be attached to a kitchen table so as to form a bench suitable for light work is shown by Figs. 1 and 2. Fig. 3 is a plan of the attachment with the top removed. The only damage to the table will be the boring of one hole through two legs for two bolts that hold the attachment.

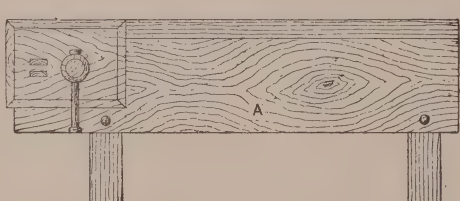


Fig. 1.—Side Elevation ot Table Attachment

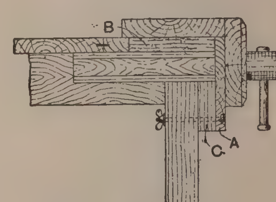


Fig. 2.—End View

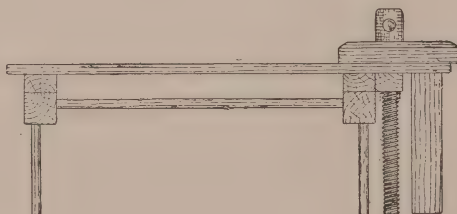


Fig. 3.—Plan with Top Removed

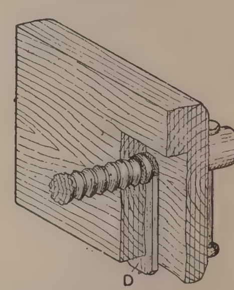
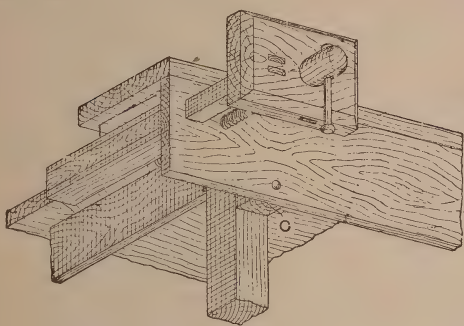


Fig. 4.—Method of Fixing Screw to Cheek

The cheek of the bench is formed by the board A. The plank forming the top and this cheek should be firmly screwed together at right angles. Next obtain a wooden screw and box, or nut; a wooden screw cheek must also be prepared, and a runner. Prepare a box of wood about 1 in. thick, to fit the runner. The bench cheek must next be mortised for the runner and the box fixed to it, and also the plank forming the top. It will be necessary to insert a block B (Fig. 2) between the box and the top. The screw cheek can be bored to receive the screw, and to hold these two together properly it will be necessary to mortise through from the

bottom edge of the cheek into the hole to receive the screw, as indicated in Fig. 4. Then a piece of hardwood D, shaped to fit into the groove made in the plain part of the screw, will hold the screw and cheek



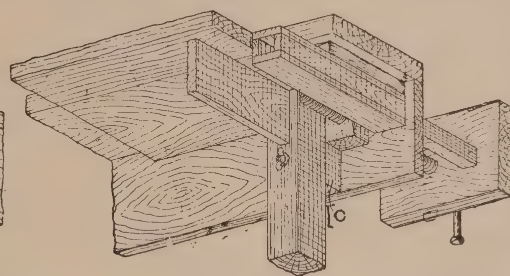


Fig. 6.

Figs. 5 and 6.—Perspective Views of Bench Attachment showing Construction

properly together. Now the hole for the screw in the cheek of the bench can be cut out and the nut screwed into position behind it. When this part is complete,

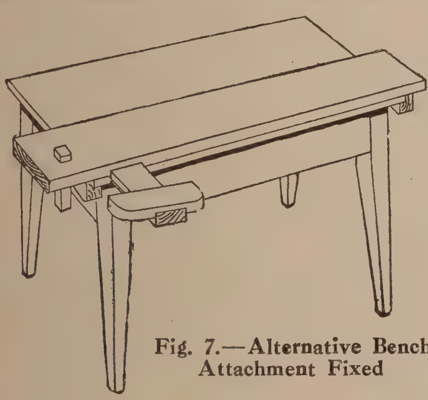


Fig. 7.—Alternative Bench Attachment Fixed

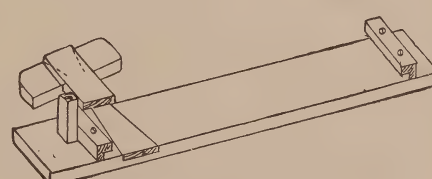


Fig. 9.—Underneath View of Attachment

Fig. 8.—Wedge Grip

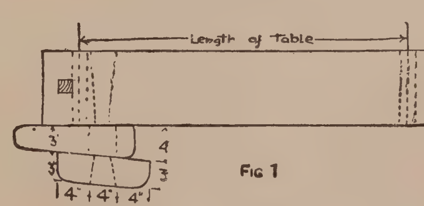


Fig. 10.—Plan of Attachment

place it in position on the table. Then prepare two blocks C (Figs. 2, 5, and 6), which fit between the legs and the bench cheek, and secure these blocks to the cheek with a couple of screws in each.

Finally bore through the cheek, the blocks, and through the two legs for a bolt, which can be tightened up at the back by an ordinary nut, or by a fly-nut, as shown in Figs. 2 and 6. It will be best to sink the head of the bolt so that it does not project and damage the work.

Alternative Arrangement.—An even simpler arrangement is shown in Fig. 7. A plan of the working top is shown in Fig. 10.

It consists of a piece of white pine 8 in. longer than the table, so that it projects 5 in. at one end and

3 in. at the other. The reason that a greater projection is required at one end is to give room for the bench pin. The width of the working top may be 9 in. and the thickness $1\frac{1}{2}$ in. The top is secured to the table by means of two checked fillets, which allow the top to slide off and on easily. These are shown clearly in an inverted position in Fig. 9. The wedge grip is secured to the top by a piece of 4-in. by $1\frac{1}{2}$-in. framing which is dovetailed across the top, and is also dovetailed on the opposite end to receive the lug. A sketch of this piece ready for jointing to the other pieces is shown by Fig. 8. The long dovetail, which is also half-checked, is fitted to the top, while the small one is for the lug. By half-checking the long dovetail a check is formed and keeps the working top from being forced out of position while the work is going on. The thickness of the wedge should be $\frac{3}{4}$ in., and is fitted well forward to allow an average thickness to be held in position.

The bench pin is $1\frac{1}{2}$ in. by $1\frac{1}{2}$ in. square, and is fitted into a hole which is cut through the working top. The best position for it is against the front checked fillet, and as this part depends only on the tightness of the fit, it should be made of well-seasoned timber.

BENCH TOP WITH VICES

A design fitted with light side and end vices is shown in Fig. 11.

The timber used should be thoroughly seasoned. Four window-sash screws, 5 in. by $\frac{3}{8}$ in., will be required. If the bench is wanted for heavy work, it will be advisable to use $\frac{7}{16}$-in. screws. Two 3-in. hand cramps, such as fretworkers use, and two bars of wrought-iron, 1 in. by $\frac{3}{8}$ in. and 9 in. long, with five countersunk holes drilled in each will be required for fastening the bench in position.

The bench-top A (Figs. 11, 12, and 13) is a $1\frac{3}{4}$-in. deal board, 4 ft. long by 9 in. or 10 in. wide. Choose the best side for the face, and plane it up quite true, squaring up all the other sides from it. The mortises for the movable stop B (Fig. 11) are 1 in. by 2 in., and 2 in. from the front edge of the bench, a convenient distance apart being 5 in. (*see* Fig. 12). A piece of oak quartering, 2 in. square when planed up by fully 3 ft. 9 in. long, will be wanted for the two vices. Saw off a 6-in. length for the tail vice C (Fig. 11) and mortise a 1-in. by 2-in. hole through the centre for the stop D. Next mark the position of the thumbscrews E, centrally in the thickness of the bench-top, and 1 in. from each end of the block. Bore with brace and bit, and let in the washer plates F (*see also* Fig. 14) across the way of the grain. Mark the centres for the screws on the end of the bench, to coincide with the holes in the block, taking care that the mortise in the block falls in line with those in the bench-top; then with a centre-bit bore the recess for the boss on the nut plate G (Fig. 14), and the smaller ones for the thumbscrews, afterwards letting the plates in flush on the outside and firmly fixing them with screws. The oak stops B and D (Fig. 11) should be a moderately tight fit in the mortises, and, as the movable stops C cannot be knocked up from underneath, a recess $\frac{1}{4}$ in. deep is made in the back, $\frac{3}{8}$ in. from the top. Opposite this an inclined sinking is made in the top of the bench, so that a $\frac{1}{4}$-in. chisel can be inserted to force up the block as required.

The remaining 3-ft. 3-in. length of quartering is for the side vice H, which is fitted in the same manner as the tail vice, except that the top face stands $\frac{1}{8}$ in. higher than the top of the bench, so that when a number of narrow strips of stuff have to be planed, they can be placed side by side on the bench, between the vice, and a slip of wood nailed or screwed to the bench. The same purpose is served by using two or more stops knocked into the mortises, the strips to be planed being forced against these by pressure from the vice. This vice is fixed 1 in. from the end of the bench, so as to leave room for one of the small cramps, the thickness of which is cut out of the top and front edge of the bench as at J, so as to be level on the outside. The other cramp fits into the recess K at the opposite end of the bench.

The two iron bars are fixed underneath the bench across the grain, and firmly screwed to keep it from warping. The bar next to the tail vice should be fixed close to the end of the board, to act as a stop against the end of the table, whilst the bar near the other end of the bench is let in level on the under side. Before these plates are drilled it should be ascertained that the holes for the screws will be out of the way of the screws securing the vice.

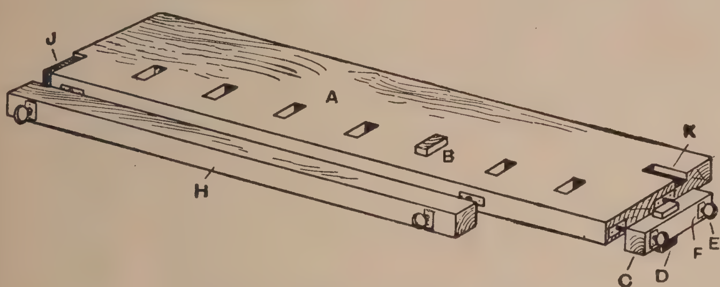


Fig. 11.—Bench Top with Vice

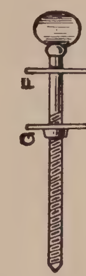


Fig. 14.—Vice Screw

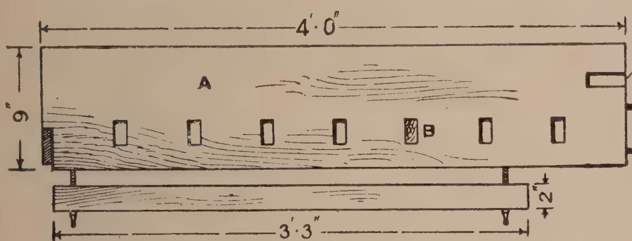


Fig. 12.—Plan of Bench Top

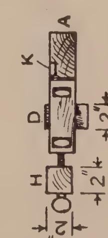


Fig. 13.—End Elevation

FOLDING BENCH

Figs. 15 and 16 show a bench for fixing against a wall, so that it will hang down the side of the wall when not in use. Plug a piece of 4-in. by 1½-in. deal firmly to the wall, the same length as the proposed bench and 1 in. lower than the top will be (*see* A, Fig. 16), and on this screw a piece of 3-in. by 1-in. stuff of the same length, as at B. Make the bench of three boards in width, the front one 1½ in. thick, the others 1 in., fixed together with three ledges screwed on. These must also be 1½ in. thick, and cut out at the front so as to fit all three boards; and leave them plain at the top. Make two frames, as C, of about 3-in. by 1¼-in. stuff, 6 in. less in length than the bench, and the same height as the latter has to be, and hinge them to the outside ledges so that they will fold inwards. Then hinge the bench to the back piece B, using wrought-iron flap hinges, and scribe the bottoms of the frames C to the floor, so that the whole weight of the bench will rest on them, not on the hinges; and the result will be a good firm bench. If a bench more than about 5 ft. long is required, three hinges should be used at the back; and the bench will be considerably firmer if a stretcher is made with notches to fit over the bottom rails of the two frames which form the legs, to keep them from spreading, and a pair of braces hinged to it at the ends, the latter cut the right length to squeeze tightly in at each side of the middle ledge, as shown by dotted lines in Fig. 15. If a vice is required, use

one of the self-fixing ones, which clip the boards of the bench by means of a screw underneath. The proper height of a bench is from 2 ft. 9 in. to 2 ft. 11 in., according to the height of the user.

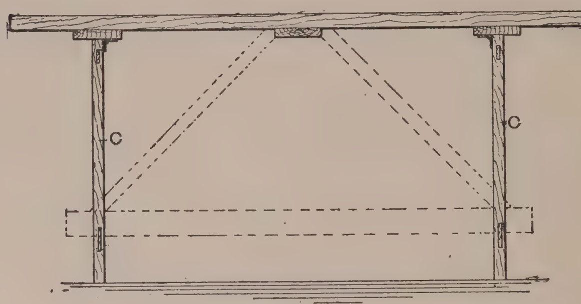


Fig. 15.—Front Elevation of Folding Bench

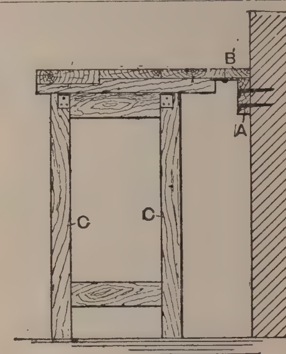


Fig. 16.—End Elevation

To dismantle the bench, it is only necessary to fold the legs towards one another, and it will fold down to the wall, with the legs out of sight.

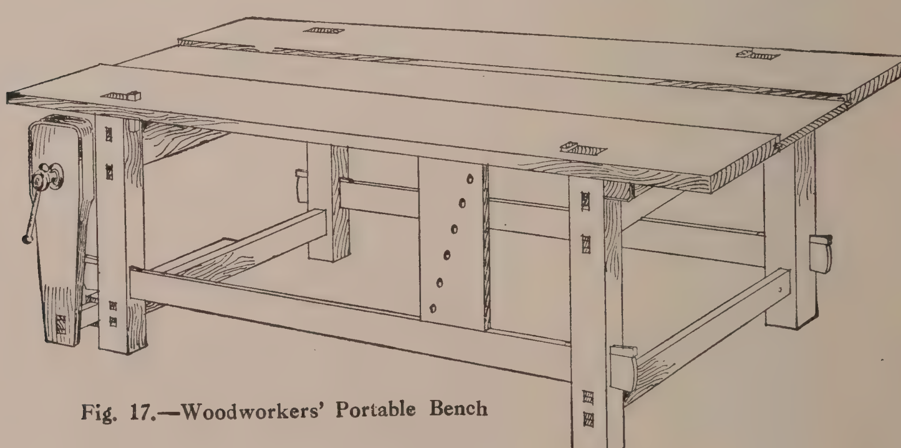


Fig. 17.—Woodworkers' Portable Bench

WOODWORKERS' PORTABLE BENCH

The bench shown by Figs. 17 to 19 can be quickly taken apart or erected, and being in three primary portions, it is more readily handled than a bench of the folding type.

The top is mortised to drop over tenons formed on the posts (Fig. 20), and is secured to the posts with wedges. It is made of three planks, the two outer ones being 11 in. by $1\frac{7}{8}$ in., and the centre one being 12 in. by 1 in. rebated to fit grooves on the outer planks. Stout battens are screwed to the underside, the end battens abutting against the outsides of the posts (*see* Fig. 19). The posts are a fixture in pairs; but are joined longitudinally by two rails, with half dovetailed bare-faced tenons secured with wedges. The rails

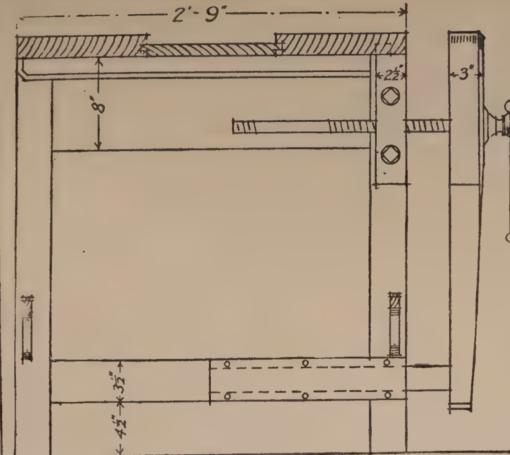


Fig 18.

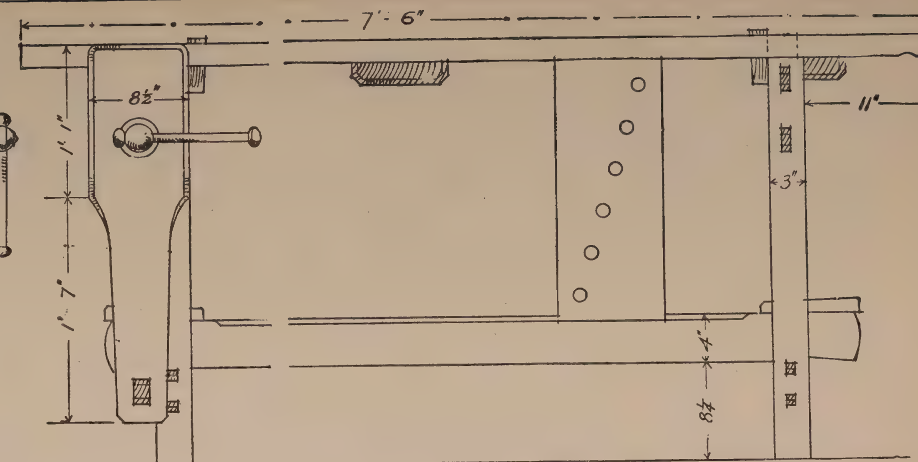


Fig. 19.

Figs. 18 and 19.—End and Front Elevations of Portable Bench

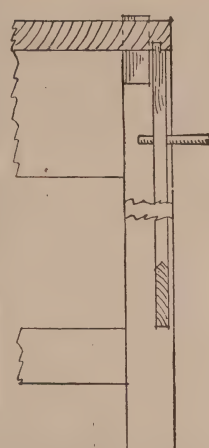


Fig. 21.—Details of Sliding Rack

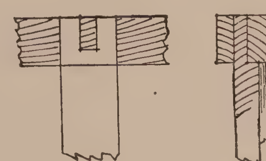


Fig. 23.—Sections of Cross Rails

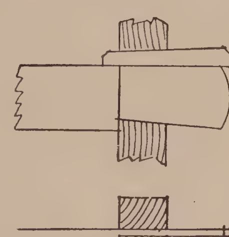


Fig. 24.—Longitudinal Rails

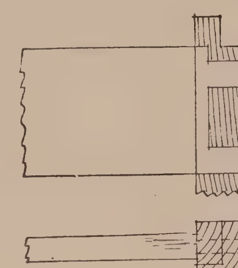


Fig. 20.—Joint of Top Cross Rails

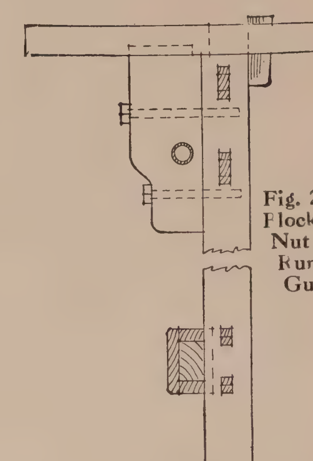


Fig. 22.—Block for Nut and Runner Guide

and wedges (Fig. 8) should be numbered to their respective places, and a hole bored in each wedge, so that, if necessary, they may be corded together to prevent loss during transit. The front rail has a double chamfer worked on its top edge to retain the sliding rack, The top edge of the rack fits in a groove under the top of the bench, as shown in section by Fig. 21.

Two forms of vices are shown. Each constitutes a part of the particular section to which it is attached, and in no way interferes with the dismantling of the bench. Fig. 22 shows the back cheek of

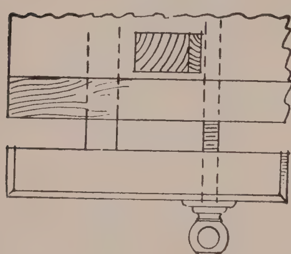


Fig. 25.—Plan of Alternative Form of Vice

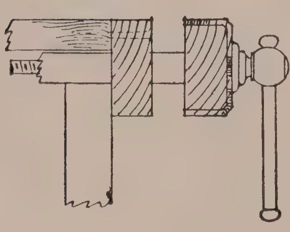


Fig. 26.—End Elevation of Alternative Form of Vice

the vice with the carrying nut; it is secured to the post with two stout coach-screws. The runner guide extends half-way along the lower rail, a strip $3\frac{1}{2}$ in. by $\frac{1}{2}$ in. being attached to the rail, as the latter does not come flush with the post (*see* Fig. 23). The vice shown by Figs. 25 and 26 requires the addition of a side plank, $1\frac{3}{4}$ in. by 6 in. or 7 in. deep, screwed to the top. It is secured at the back with blocks, more particularly near the vice, but, of course, kept clear of the screw and runner. A vice is sometimes fitted at the opposite diagonal.

The wedges securing the top of the bench are shown projecting $\frac{1}{2}$ in. or more above, merely to indicate their position more clearly. They should be flush, excepting the one next to the vice, which may be used as a bench stop. The vice runners and wedges should be of some hardwood, such as beech, ash, or teak; the remainder of the bench can be of deal. A suitable height for the bench would be 2 ft. 10 in. from the ground to the under-side of the top, which should be of $1\frac{7}{8}$ in. stuff.

BENCH WITH SIDE AND TAIL SCREWS

The bench fitted with side and tail vices shown by Fig. 27 is extremely useful for cabinet-making and similar work, where it is desirable to hold pieces of material that may have to be planed, moulded, chamfered, mortise-grooved, etc., without using a bench knife or similar method of fixing. The dimensions on Figs. 28, 29, and 30, of course, can be altered to meet requirements. The whole may be constructed of hardwood, such as beech or birch, and in any case it will be best to have hardwood for all the parts forming the top, side cheeks, and cheeks of screws, these being the main parts of the bench; the framing of the legs, rails, etc., might be of red deal. Fig. 30 is a section on A A (Fig. 28).

Having sawn out the pieces, next plane them true. Then the legs and rails should be set out, the latter for mortising, and the former for tenons. The mortises go right through, producing a much firmer result than when the tenons are only stubbed in half way. The haunched mortise and tenons between the top rails and legs, with the tenons of the cross rails through the legs, are shown in Fig. 31. The side rails are dovetailed, mortised, and tenoned together, as in Figs. 31 and 32, where it will be seen that the tenon of the rail is firmly held in position by a wedge, which must be released, and the tenon of the rail lifted up before it can be with-drawn. The side rails have a bare-faced tenon, that is, have a shoulder on the inside only. When these joints fit satis-factorily, the legs and cross rails should be glued together and cramped up and

the tenons fixed with wedges, which should be glued before insertion.

The top should be planed to breadth and thickness, and then the ends cut off and planed square and to length. The front of the back and end cheeks (Fig. 29) should next be carefully set out and worked. At the front end of the side cheek B (Figs. 28 and 29) the thickness for dovetailing is not the full 2 in., but is less by $\frac{3}{4}$ in., the breadth of the pin hole, as shown at Fig. 29. After the side cheeks have been dovetailed and fitted together, the front cheek should be grooved on the back for receiving the stop (*see* Figs. 29 and 33). The inside edge of the top should be rebated as shown at Fig. 30 to receive the well board. This should fit just tight between the end cheeks, the front side and back cheeks being firmly secured to the top plank and well board. Four-inch screws may be used for the front and side cheeks and $2\frac{1}{2}$-in. screws for the back, the heads being sunk a little below the surface. It will be found advantageous to glue the side cheeks to the main board of the top. The cheeks and ends of the runners should be mortised and tenoned together, as shown by Fig. 34, the top of the runner being kept at the same distance from the top of the cheek as the thickness of the top plank; two tenons may be more difficult to make; but the result will be stronger than when one tenon only is used. These joints should be firmly glued and wedged together with the runner at right angles to the cheek.

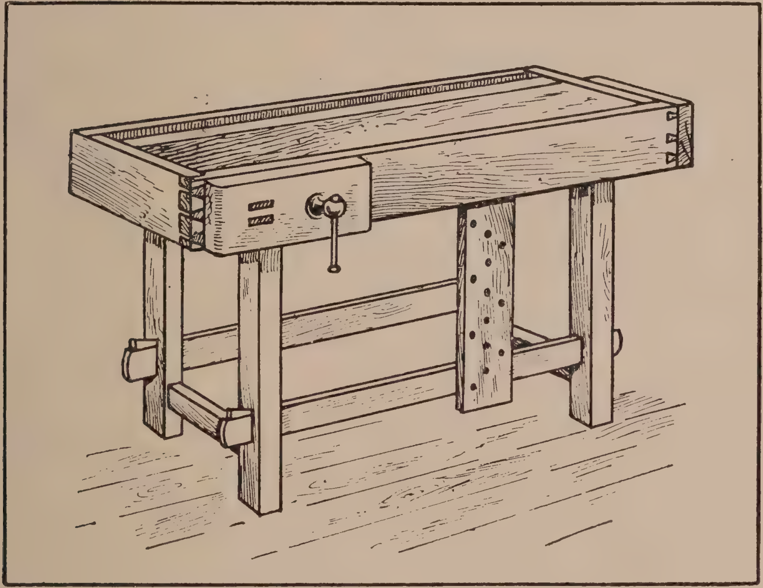


Fig. 27.—Bench with Side and Tail Screws

The construction of the guide boxes for the runners is clearly shown in Figs. 30 and 33, the pieces, a trifle deeper than the thickness of the runner, being firmly fastened to the top plank with $3\frac{1}{2}$-in. screws. The bottom is formed of $\frac{3}{4}$-in. boarding screwed to the guides. The box for the tail runner extends from the top rail to the inner surface of the end cheek. Wrought-iron bench screws about 18 in. by $\frac{7}{8}$ in., having split collars, will be found most satisfactory, and in fixing them into their places, the cheek and runner should be pushed in and firmly held in position; then the centre of the hole for the screw in the cheek should be marked, sufficient room being allowed for the flange of the

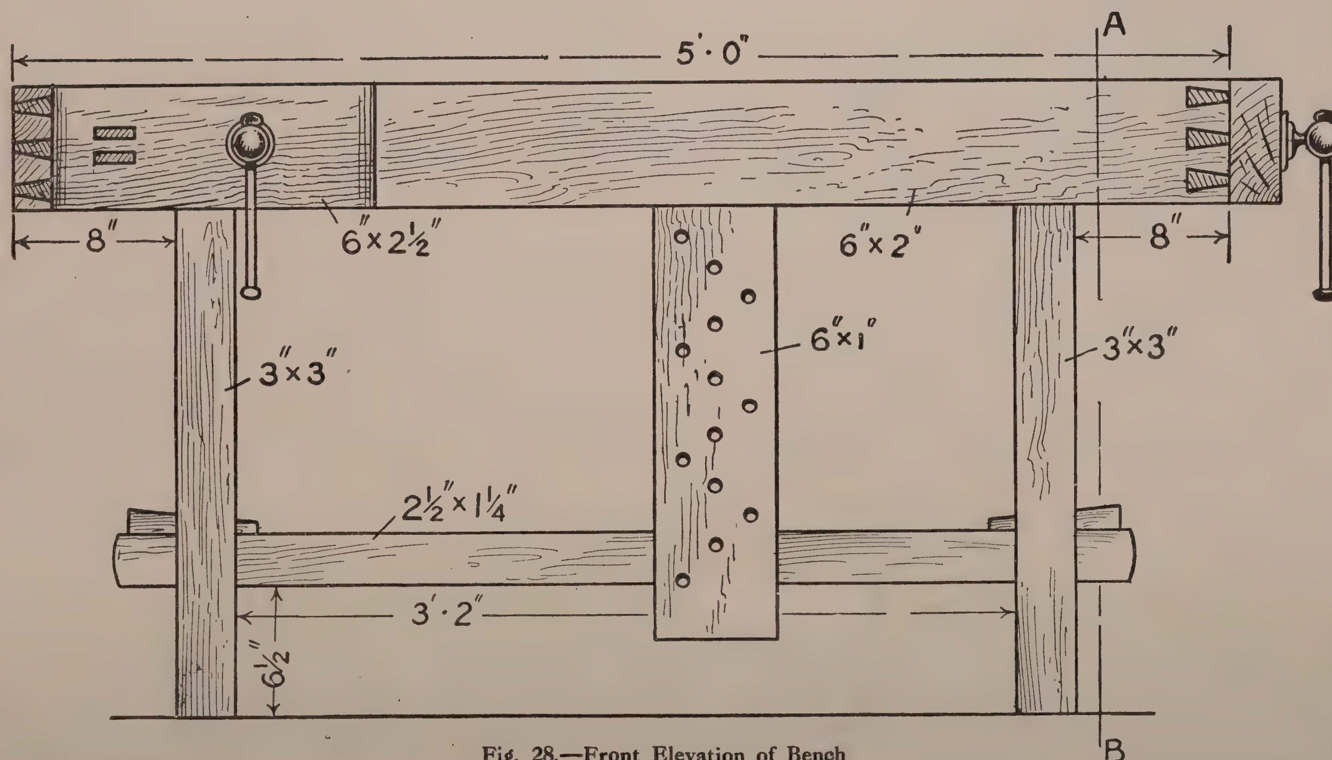


Fig. 28.—Front Elevation of Bench

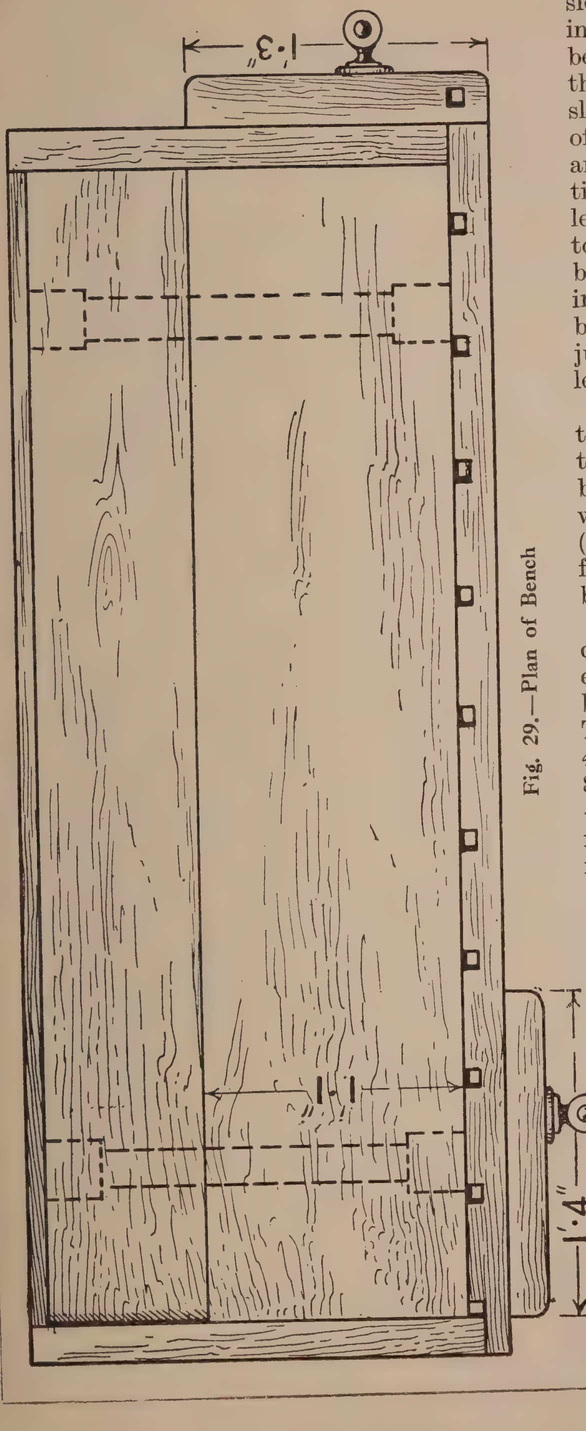


Fig. 29.—Plan of Bench

box (or nut) for screwing to the side cheek of the bench, as shown in Fig. 33. The hole should next be bored through the cheeks of the screw and bench with a bit slightly larger than the diameter of the screw. Then the collars and boxes can be fixed in position, and the framework of the legs and top fitted together. The top rail of the back legs should be notched for the runner, as shown in Fig. 31, and if the work has been done accurately the top will just slide on the upper part of the legs.

When the parts are adjusted, the front cheek should be secured to the legs and the top of the bench to the top rails of the legs with $3\frac{1}{2}$-in. screws. The peg board (Fig. 28) should be screwed to the front of the bottom rail and the back of the front cheek.

The following are the net sizes of the pieces required; a little in excess of these dimensions should be allowed for waste in working. Top board, 2 in. by $13\frac{1}{4}$ in. by 4 ft. 8 in.; well board, $\frac{3}{4}$ in. by 8 in. by 4 ft. 8 in.; peg board, $\frac{7}{8}$ in. by 6 in. by 1 ft. 9 in.; runners, 2 in. by $2\frac{1}{2}$ in. by 2 ft. 3 in.; runner guides, $1\frac{1}{2}$ in. by 2 in. by 3 ft. 2 in.; guide box bottoms, $\frac{3}{4}$ in. by $5\frac{1}{2}$ in. by 1 ft. 7 in.; screw cheeks, $2\frac{1}{2}$ in. by 6 in. by 2 ft. 7 in.; front and end cheek, 2 in. by 6 in. by 9 ft.; back cheek, 1 in. by 6 in. by 5 ft.; legs, 3 in. by 3 in. by 9 ft. 8 in.; top rail (front end), 2 in. by 4 in. by 1 ft. 9 in.; top rail (back end), 2 in. by $4\frac{1}{4}$ in. by 1 ft. 9 in.; bottom rails (ends), 2 in. by 2 in. by 3 ft. 6 in.; and bottom rails (front and back), $1\frac{1}{4}$ in. by $2\frac{1}{2}$ in. by 8 ft. 2 in.

It will, of course, be understood that the above are the *finished* sizes, hence the need for the allowance mentioned.

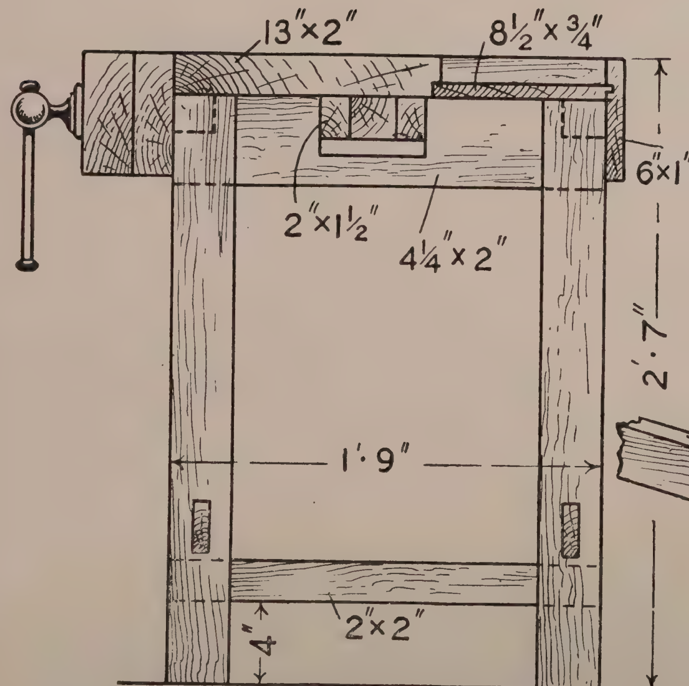


Fig. 30.—Section of Bench on A B (Fig. 28)

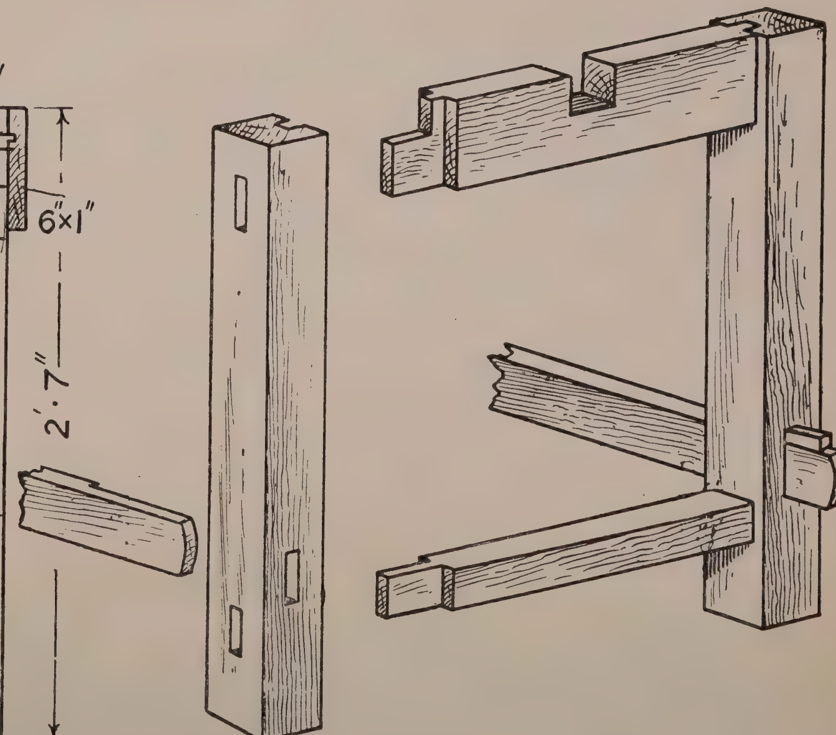


Fig. 31.—Joints of Rails and Legs

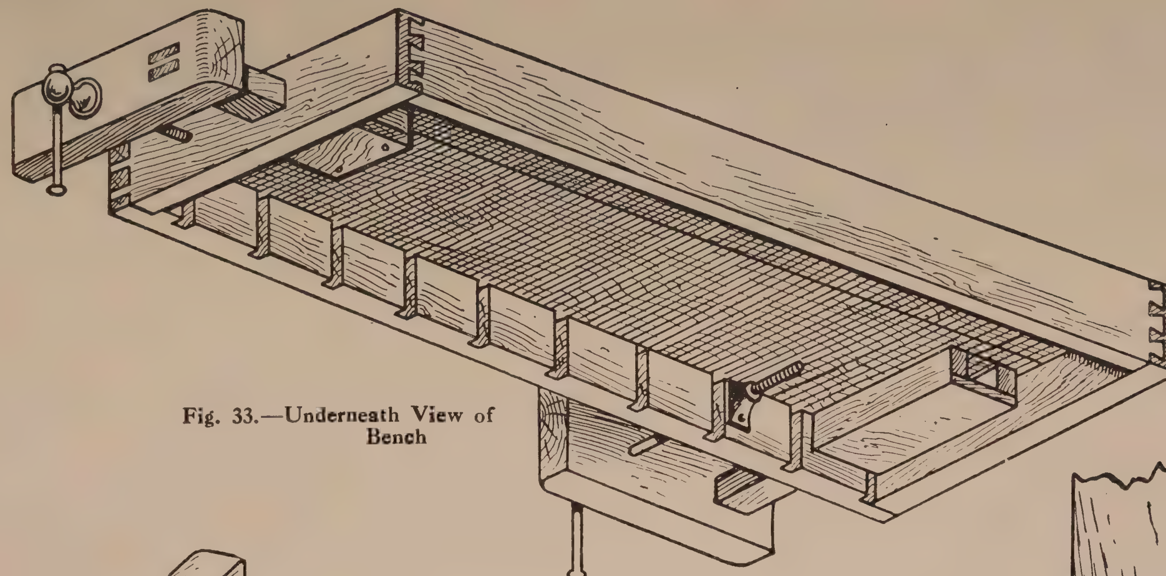


Fig. 33.—Underneath View of Bench

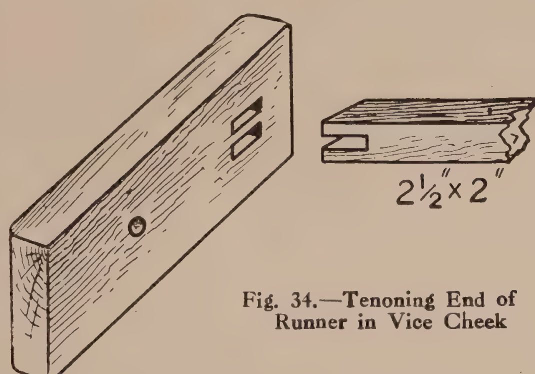


Fig. 34.—Tenoning End of Runner in Vice Cheek

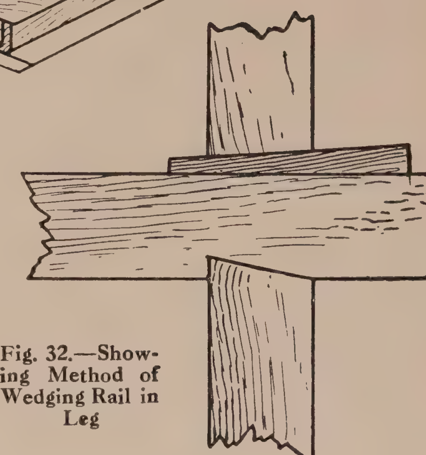


Fig. 32.—Showing Method of Wedging Rail in Leg

ALTERNATIVE DESIGN FOR BENCH

The illustration Fig. 35 shows a carpenter's bench 6 ft. long, 2 ft. wide, and 2 ft. 6 in. high, which has a side vice and an end vice. The latter is especially useful in holding any piece of work securely on the bench, for it can be gripped between stops or wooden pins, one of which occupies one of the holes in the top of the bench, and the other a hole in the upper edge of the end-vice cheek (*see* Figs. 35 and 36). With the exception of the vice cheeks, which must be of hardwood, such as beech, all parts may be constructed of red deal.

The top consists of two boards, 5 ft. 9 in. long, $1\frac{1}{2}$ in. thick, and $10\frac{1}{2}$ in. wide, which are joined by two rails screwed across their under surface, as shown in Fig. 37. These rails are 1 ft. long, 1 in. thick, and 3 in. wide, and are secured at a distance of one-third of the length of the top boards from each end. Notches are cut in the front edge to provide the holes for the stop, as shown in Fig. 33. They are 1 in. square, and are situated at intervals of 6 in. To give greater depth, glue and screw a 3-in. wide strip of $1\frac{1}{2}$-in. stuff, 5 ft. 9 in. long, to the under surface, to be flush with the front edge. Fig. 38 shows this detail. Mark with the square the positions of all the notches on the double edge, carry the ends of each line over the board, and strip to the extent of 1 in., and connect the terminations of each couple. Then cut out with a saw and chisel.

The side and end cheeks or boards are also of $1\frac{1}{2}$-in. stuff. The former are 6 ft. long, the latter 1 ft. 9 in., while the width of all is 9 in. (The measurements given in this article are those of the boards after planing ; therefore $\frac{1}{8}$ in. must be added to the thicknesses to allow for finishing.) Before these four cheeks are secured to the top and to each other, a hole for the vice screw must be cut in that of the front, and two holes are to be cut in an end piece for the tail vice screw and runner. The screw nuts can then be attached. The screws for both these vices are the common wooden screws (Fig. 39). If iron ones are preferred, the necessary alteration in the fitting of these parts is easily accomplished.

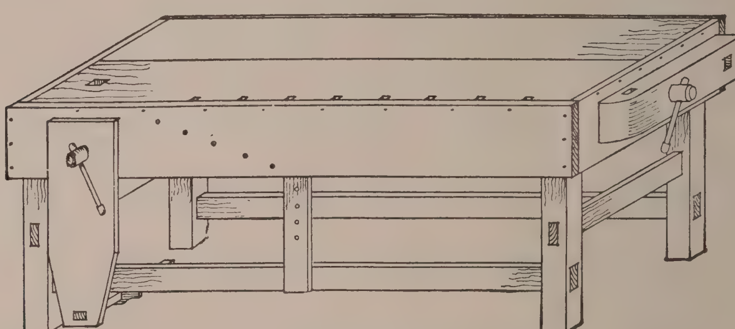


Fig. 35.—Alternative Design for Bench

At the distance of $9\frac{1}{2}$ in. from the left-hand end of the front cheek, and $2\frac{1}{2}$ in. from the bottom edge, place one leg of a pair of compasses, and describe a circle equal to the diameter of the screw, say 2 in. With a keyhole saw cut out the stuff, first boring a hole large enough to admit the blade. The screw should fit the hole easily. Fig. 40 shows the nut of the front vice screw fixed in position on the inside of the board. To obviate the necessity for using long screws, the thickness of the nut is reduced one-half at each corner as shown. The screw-hole for the tail vice is of similar diameter. Its centre is 6 in. from the front extremity of the right-hand end of the top, and 4 in. from the upper edge. At a distance of 11 in. from this end make the hole for the casing of the vice runner. It is $3\frac{1}{2}$ in.

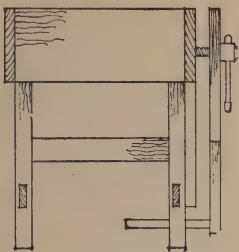


Fig. 36.—End Elevation of Bench

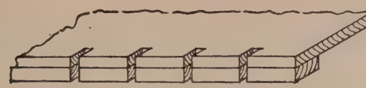


Fig. 38.—Detail of Bench Top

Fig. 39.—Wooden Bench Screw

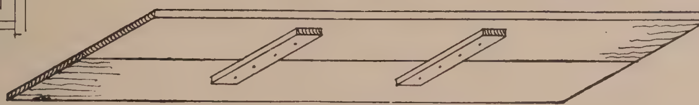


Fig. 37.—Bench Top

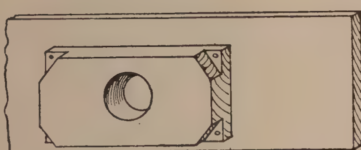


Fig. 40.—Nut of Front Vice Screw

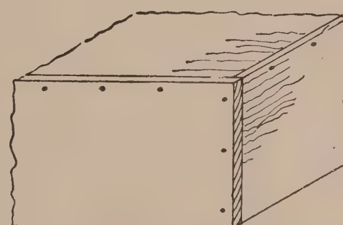


Fig. 42.—Details of Corner

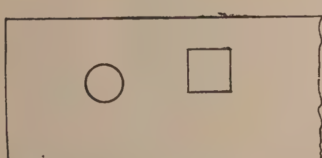


Fig. 41.—Position of Holes for Tail Vice and Runner

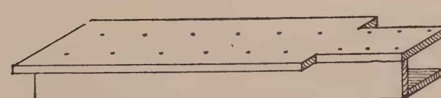


Fig. 43.—Runner Casing

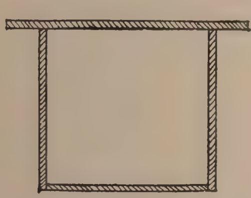


Fig. 44.—Front Elevation of Runner Casing

Fig. 46.—Leg, showing Position of Mortises

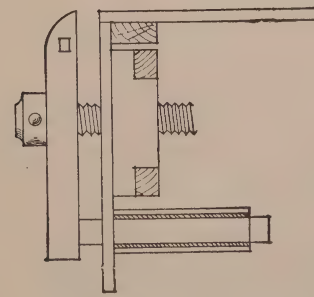


Fig. 45.—Side Elevation of Vice

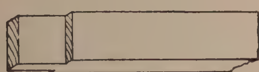


Fig. 47.

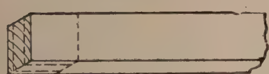


Fig. 48.

Figs. 47 and 48. Tenons of Rails

square, and is $1\frac{1}{2}$ in. from the upper edge. Fig. 41 shows the appearance of the board when these holes have been made. Screw the parts together. Fig. 42, which is a detail of one of the corners, shows that the front board (and consequently the rear board) is screwed to the edges of the end boards. Dovetail joints can be used if desired.

Next arrange the runner casing, which is a long square tube attached to the under surface of the bench top, and designed to ensure the runner of the vice cheek moving in and out in a straight line. Fig. 43 gives a general view of the casing, and Fig. 44 a front view. The casing is composed of four pieces of $\frac{3}{4}$-in. stuff. The upper is $5\frac{1}{2}$ in. wide, except for $1\frac{1}{2}$ in. at one end, where it is $3\frac{1}{2}$ in., so that it can pass into the hole in the end board for the casing. Two of the other pieces (those for the sides) are $2\frac{3}{4}$ in. wide, and 2 in. is the width of the bottom length. All are 1 ft. long. Before they are screwed together, place the runner in the tube while the sides are being secured to the top. The runner is 1 ft. 6 in. long and 2 in. square, and should fit the casing freely. The projecting edges of the upper length enable the casing to be screwed to the top of the bench as shown in Fig. 45, which represents the vice in a state of completion; that is, with the addition of the vice cheek and runner, the top of the bench being supposed to be removed. It will be seen that the front of the casing enters the hole of the end board, and is flush with its outer surface. As the nut of the screw is 8 in. long, it will be seen that between it and the front there is a space of 2 in., which will provide room for one of the legs.

The legs should next be cut out and fixed in place. They are about 2 ft. $4\frac{1}{2}$ in. long, 3 in. wide, and 2 in. thick. The rails connecting them near the lower end are tenoned into them. Each leg requires a couple of mortises made in it, one for the end and the other for the front or back rail tenon. At a distance of 5 in. from one end of a leg, square a line across all faces, and repeat 3 in. distant. Connect those crossing the narrow or 2-in. wide faces by a couple of lines, each $\frac{5}{8}$ in. from the edge. This indicates the position of the mortise. The other mortise is situated 3 in. distant from, or above, the first, and is made in the wide faces of the wood; it is 3 in. long and $\frac{3}{4}$ in. wide. The remaining legs should be treated in the same way. Fig. 46 shows the lower part of one of them.

The front and back rails are 5 ft. 9 in. long, the end rails being 1 ft. 9 in. The tenons of the front and rear rails are exactly similar, while those of the end rails differ only in the fact that they are 1 in. shorter. Fig. 47 shows one of them, and Fig. 48 the method of setting out the work. For a front or back rail run a pencil line round the stuff 3 in. from the end. Mark two other lines between one of the lines crossing the 2 in. face and the end, and let them be parallel with, and $\frac{5}{8}$ in. from, the edge of the wood. Repeat on the opposite side and connect the lines over the ends, as shown in Fig. 48. Then with a saw make the four cuts necessary to produce the tenon, which should fit its mortise firmly, but not so tightly as to split the wood. The end rail tenons are similarly set out, but the shoulder line is 2 in. from the end instead of 3 in. Glue the tenons in the mortises, and add a nail or a wood peg. Then screw to the bench top, letting the latter be turned upside down during the operation.

Before cutting out the cheeks for the vices, complete the immovable parts of the bench. One only remains to be done; this is the peg board, the strip of wood that contains the holes for the wooden peg designed to support in the vice boards which need such assistance. This board is 1 ft. 4 in. long, 3 in. wide, and $1\frac{1}{2}$ in. thick. It reaches from the lower edge of the front board to the lower edge of the front rail, to which it is screwed. To make a firm joint between the upper extremity and the bench, a piece of 1-in. wood, 3 in. wide and 8 in. long, should be screwed across the joint at the back, as shown in Fig. 49. Midway between the ends of the bench is about the best position for the peg board. Bore holes in it and in the front cheek of the bench to take a wooden peg $\frac{1}{2}$ in. in diameter.

Fig. 35 suggests the number and position of these. Fig. 50 is a view of the cheek and runner of the tail vice. The cheek is 1 ft. 5 in. by 7 in. by 3 in., and one end may be rounded as shown.

The hole for the bench screw is just large enough to admit the screw; its centre is $7\frac{1}{2}$ in. from this rounded end and 4 in. from the top edge. From the bottom edge bore a $\frac{1}{2}$-in. hole through to the screw aperture, so that a hardwood key A may be driven to fit into the collar on the bench screw (Fig. 51). The object of the key is to ensure the vice cheek moving out with the screw when the latter is twisted to the left. The runner and cheek are united by tenon and mortise. Accurately measure the position for the mortise on the vice cheek, indicating it by drawing a 2-in. square in pencil on both sides. As the end of the runner has a tenon 2 in. by $1\frac{1}{2}$ in. (*see* Fig. 52) the mortice must correspond. Therefore two lines are drawn parallel with, and $\frac{1}{4}$ in. from, the sides of each square (*see* Fig. 53), and the mortise is made accordingly. The tenon is long enough to occupy the mortise from the front to the rear surface of the cheek, and care must be exercised to ensure a good fit. The hole in the upper edge of the cheek for the peg is on a line with the holes of the bench top. It should be at least 3 in. deep, and is 1 in. square. The cheek for the other vice is 2 ft. 4 in. long and $1\frac{1}{2}$ in. thick, its width at the top extremity being 8 in. and at the bottom 4 in. The hole for the screw has its centre $6\frac{1}{2}$ in. from the upper end, and midway between the side margins.

Fig. 49.- Junction of Peg Board and Bench

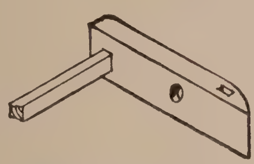
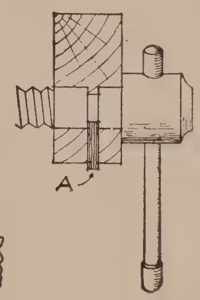


Fig 50.—Cheek and Runner of Tail Vice

Fig. 51.— Bench Screw



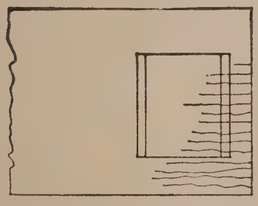


Fig. 53.—Mortise for Tenon of Runner

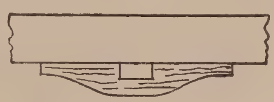


Fig 54.—Socket for Runner

Fig. 52.—Runner

The runner is 1 ft. long, 2 in. wide, and 1 in. thick, and is pierced with $\frac{3}{8}$-in. holes at close intervals from a point $1\frac{3}{4}$ in. from the front end. It is mortised into the cheek, so that it is in contact with the lower edge of the front rail. The widest surface is horizontal. The mortise is 1 in. square, and passes through the cheek. Therefore the tenon of the runner has its width reduced one-half, $\frac{1}{2}$ in. being taken off each edge to the extent of $1\frac{1}{2}$ in.

A socket for the runner to work in is provided and nailed to the lower rail, as shown in Fig. 54. It should be flush with the front surface. A peg 2 in. long is provided for the runner, and two stops, each 4 in. long, are prepared for the bench and the tail vice. About 10 in. from the front of the bench, and 4 in. from the left-hand end, is a suitable position in

which to fix a bench stop to hold a board during the operation of planing.

WATCHMAKERS' BENCH

The watchmakers' bench shown by Figs. 55 to 59 is 3 ft. 6 in. long by 3 ft. 3 in. high by 1 ft. 9 in. deep. It contains eleven various size drawers and a sliding tray. The top is in solid mahogany 1 in. thick, with a rim along the front and ends, the latter diminishing to the front. Figs. 60

Fig. 55.—Watchmakers' Bench

and 61 are elevations of the parallel front to the bench and of the panelled end.

The front and ends are framed and panelled in American whitewood, and are 1 in. thick. Fig. 62 is a detail of the angle of the panelled framing. Fig. 63 is a section through the bench top. The tray for jewellers' work rests on runners, as shown in Fig. 64. The standard at the end of the nest of drawers, also the shelf immediately above the tray (Fig. 65), may be either in whitewood or pine, prepared from 1-in. material. The rails and drawer runners are prepared in mahogany, and the dustboards (*see* Fig. 58) either of deal or pine. The front and sides and side slips of the drawers are in mahogany, and the bottoms may be either of whitewood or pine. The fronts of the drawers are raised as shown in the detail (Fig. 66). Fig. 67 is a detail of the drawer side, showing the grooved slip with tongued bottom, and Fig. 68 is an enlarged detail of the bench top. The panels in the end framing at the right hand of the nest of drawers are flush on the inside.

A foot-wheel for a lathe may be used at the left hand of the bench, with band holes at A (Fig. 55).

The materials required for the construction of the bench are given in the following list of quantities :

For the top, one piece of mahogany 3 ft. 7 in. by 1 ft. $10\frac{1}{2}$ in. by 1 in. ; one piece 3 ft. 9 in. by 4 in. by 1 in. ; two pieces 1 ft. 11 in. by 4 in. by 1 in. ; and one piece 3 ft. 7 in. by $1\frac{1}{2}$ in. by $\frac{1}{2}$ in. For the framing stiles, four pieces of whitewood 3 ft. 3 in. by $2\frac{3}{4}$ in. by 1 in. ; and two pieces 3 ft. 3 in. by $2\frac{1}{4}$ in. by 1 in. For the muntins, four pieces of whitewood 2 ft. 11 in. by $2\frac{3}{8}$ in. by 1 in. For the rails, one piece of whitewood 3 ft. 6 in. by $5\frac{1}{4}$ in. by 1 in. ; two pieces 1 ft. 9 in. by $5\frac{1}{4}$ in. by 1 in. ; one piece 3 ft. 6 in. by $2\frac{3}{4}$ in. by 1 in. ; and two pieces 1 ft. 9 in. by $2\frac{3}{4}$ in. by 1 in. For the panels, three pieces of whitewood 2 ft. 7 in. by $11\frac{1}{4}$ in. by $\frac{1}{2}$ in., and two pieces 2 ft. 7 in. by $7\frac{1}{4}$ in. by $\frac{1}{2}$ in. For the base, one piece of oak 3 ft. 7 in. by 1 ft. 10 in. by 1 in. For the standard, one piece of whitewood 3 ft. 2 in. by 1 ft. 8 in. by 1 in. For the shelf, one piece of whitewood 2 ft. 2 in. by 1 ft. 8 in. by 1 in. For the divisions, two pieces of whitewood 6 in. by 1 ft. 8 in. by 1 in., and one piece 1 ft.

ADJUSTABLE BENCH STOP

All who are used to working at the bench know what it is to be troubled with a bench stop so firmly inserted, that it requires considerable persuasion with the hammer when it is to be properly readjusted. The contrivance shown in Fig. 69 obviates all force and is simply adjusted by means of a form of cam A, which, when turned clockwise, gradually raises the stop above the surface of the bench top.

The cam should be made of some close-grained hardwood such as oak or beech, and is fixed to the rail between the legs

Fig. 56.—Sectional Plan through Upper Part of Watchmakers' Bench

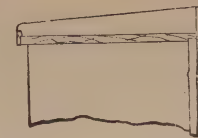


Fig. 63.—Section through Bench Top

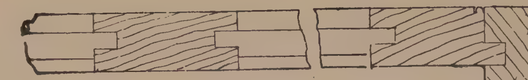
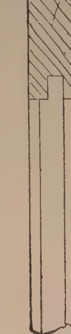



Fig. 62.—Detail of Angle of Panelled Framing

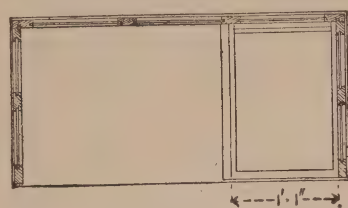


Fig. 57.—Sectional Plan through Lower Part of Bench

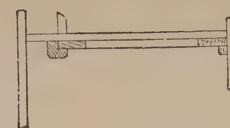


Fig. 64.—Details of Runners and Tray


Fig. 65.—Plan of Tray

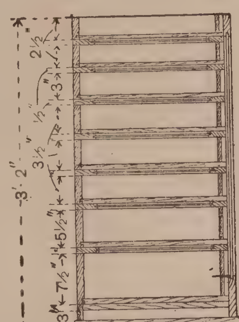


Fig. 58.—Vertical Section through Right-hand Nest of Drawers

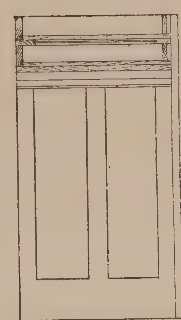


Fig. 59.—Vertical Section through Drawers and Tray

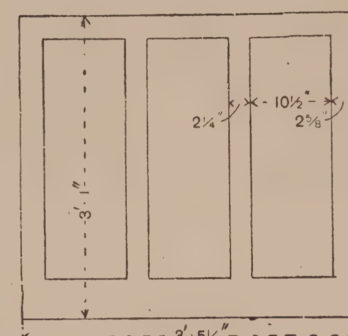


Fig. 60.—Elevation of Panelled Bench Front

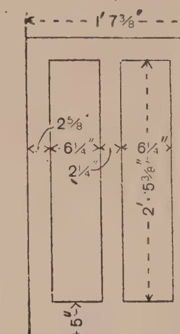


Fig. 61.—Elevation of Panelled Bench End

of the bench by means of a screw, which should be driven in just sufficiently tight to enable the cam to be turned ; a metal washer should be inserted between the cam and the rail.

An easy method of setting out the shape of the cam is as follows : Divide the circle into a number of equal parts as B to N (Fig. 70), and draw radii as shown. Divide one of the radii into twelve parts, the same number as the circumference is divided into. Then, starting the curve from the centre, on C mark one of the divisions of the radius, on D two, on E three, on F four, and so on, until the outside is reached ; then trace the curve through the points. The twelfth division finishes on B, but mark one more division on C outside the circle, and from this point draw a line as shown to the point where the curve crosses D. The scored part is the cam to be cut out in wood, the centre being the point where the screw is inserted.

To fit the cam to the bench, first place the stop in position, the top being level with the surface of the bench, and hold the cam under the end of the stop, so that the latter is resting on the part where the line D (Fig. 70) crosses. Then drive the screw in the cam. By slowly turning the wheel forwards, the stop can be raised, or by turning backwards, lowered, to such a nicety, that it can be easily adjusted to $\frac{1}{16}$ in. The stop fits quite easily in the mortise in the bench top, and is kept vertical by means of an iron guide, which could be made from a piece of stout wire.

Fig. 66.—Section through Drawer of Watchmaker's Bench

Fig. 67.—Detail of Drawer Side

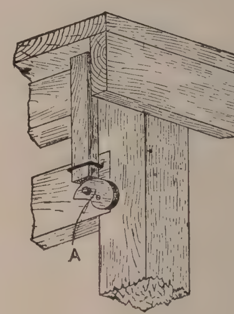


Fig. 69.—Adjustable Bench Stop

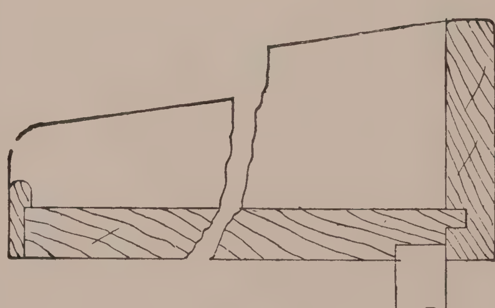


Fig. 68.—Detail of Bench Top

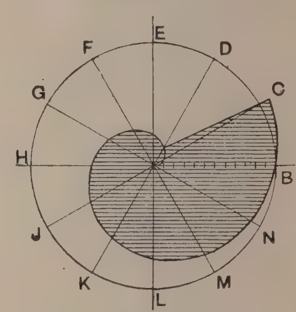
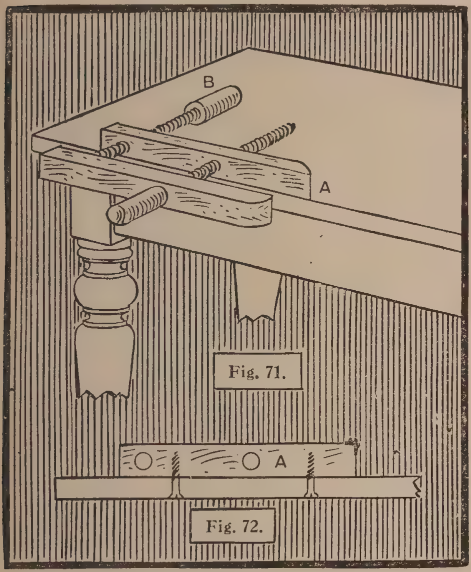


Fig. 70.—Method of Setting-out Cam

IMPROVISED BENCH VICES

In cases where a cabinetmaker's or carpenter's bench is not available, a table has to serve. For light work which has to be held vertically, such as cutting dovetails or ornamental shapes with the bow-saw, and so on, a handy contrivance is a hand-screw fixed to a table as shown in Fig. 71. One chop A (Fig. 71) of the

handscrew is secured with two screws driven from the underside of the table top, as in Fig. 72. The chop A should be



Figs. 71 and 72.—Improvised Bench Vice

exactly level with the table edge, so that the surface for the work to rest against is increased. Should the handle B of the handscrew be thicker than the chop A, and thus prevent it from turning freely, a thin piece of $\frac{1}{4}$-in. or $\frac{1}{2}$-in. stuff may be placed between the chop and the table, the iron screws passing through it, of course.

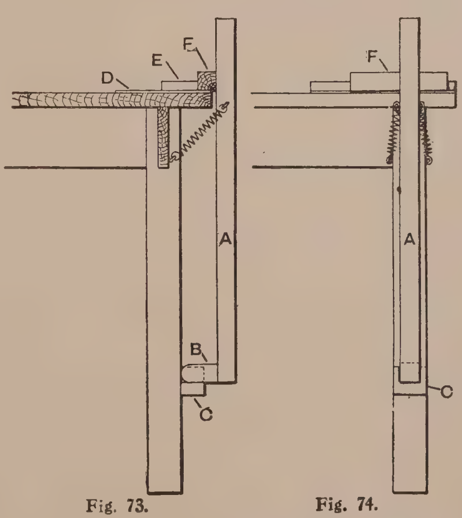
When the handscrew has served its purpose it can be taken from the bench in less than a minute, and the table can then be used for planing, etc.

Another Improvised Vice.— Another simple device is shown in Figs. 73 and 74.

A piece of quartering A, $1\frac{1}{2}$ in. square by 2 ft. 6 in. long, is taken, and a short piece cut with one end rounded is fixed to one end of the long piece to form a foot B. The length of this foot is determined by the distance which the top of the table overlaps the leg, the idea being to keep the piece A as vertical as possible, in side view, so as to grip the material square, to prevent its slipping when being cut. Next a short piece of quartering is cut and recessed to take the foot B and secured firmly to the table leg, as shown at C; this forms a step for the foot B. A couple of Bowden-brake springs are next fastened to the table leg and also to each side of the upright piece A.

It is important that these springs should slope towards the table, so as to keep the foot piece B from riding up out of the step, and, of course, the tighter these springs are stretched the tighter the vice will grip.

A thin piece of wood D is tacked to the top of the table to prevent the saw from cutting through, and a thicker piece E placed on top to form a stop. This last piece may be adjusted to suit the thickness of wood to be cut. A piece of wood in position for cutting is shown at F. It may also be placed vertically between the edge of the table and the piece A, for cutting end joints, etc.



Figs. 73 and 74.—Side and Front Elevations of Improvised Bench Vice

The whole device may be rigged up in about ten minutes and the cost, largely determined by the amount of material to hand, in any case is small.

EASILY-MADE BACK AND FRONT VICES

The front and back vices shown by Figs. 75 to 78 are constructed chiefly of wood. The only metal parts in the front vice are the screw, nut, and handle, while in the back vice, in addition to the screw, nut, and handle, an iron stay is fitted between the vice and bench; the jaws of the vice are protected with iron plates. Beech or ash should be used for the construction of it.

In the front vice (Figs. 75 and 76) the front leg of the bench acts as the back jaw of the vice. The front jaw A (Fig. 76) is 2 ft. long by 4 in. wide by $1\frac{1}{2}$ in. thick at the top, tapering to 3 in. wide by $1\frac{1}{4}$ in. thick at the bottom. The guide B is $1\frac{1}{2}$ in. wide by $\frac{3}{4}$ in. thick, mortised into the front jaw 3 in. up from the bottom, and is fixed with wedges. A mortise is cut in the leg through which the guide passes, and a number of holes are bored in the guide, into which an iron pin fits, for regulating the width of the vice at the bottom to correspond with the width at the top.

An enlarged section through the vice, showing the screw and its fittings and method of fixture, is shown by Fig. 79. The nut D, a front view of which is shown by Fig. 80, is fixed to the back of the leg with two screws. An iron plate (*see also* Fig. 81), $\frac{1}{2}$ in. thick by 3 in. in diameter, is fixed to the front of the jaw with two screws, and an iron washer E (Fig. 81) interposes between the plate and the head of the screw. The handle G is $\frac{5}{8}$ in. in diameter and 11 in. long; one end is made in the solid, while the other is screwed on, as shown at Fig. 79. The distance from the top of the bench to the centre of the screw should be about 6 in. Bench screws fitted with a nut and handle, similar to the one shown at Fig. 79, can be obtained from tool dealers.

The back vice shown by Figs. 77 and 78 has two wood jaws H (Fig. 78) 1 ft. 9 in. long by $3\frac{1}{2}$ in. wide by $1\frac{1}{2}$ in. thick. The jaws are protected at the top with iron plates J (*see also* Figs. 82 and 83), 3 in. deep by $\frac{1}{4}$ in. thick, let in and fixed with screws. The guide K is $1\frac{1}{2}$ in. wide by $\frac{3}{4}$ in. thick, mortised into the front jaw, and fixed with a bolt. The screw and its fittings are similar to that used for the front vice.

The method of fixing the vice to the bench is shown in Fig. 82. A nut is mortised into the bench from the bottom, about 2 in. in from the end, and a $\frac{1}{2}$-in. bolt with a square head passes through the back jaw and the bench, screwing into the nut. The vice is further secured with the iron stay L, of $\frac{1}{2}$-in. diameter, the ends of which are screwed to the jaw of vice and bottom of bench top.

TOOL RACK FOR BENCH

The tool rack shown in Fig. 84 will hold all the tools most commonly used by woodworkers, it rests on the top of the bench and can be adapted if necessary to serve two benches placed back to back. Figs. 85 and 86 are elevation and plan respectively. The tools provided for are: Trying, jack and smoothing planes; foot rule; tenon saw; 1 in., $\frac{3}{4}$ in., $\frac{1}{2}$ in., $\frac{3}{8}$ in., $\frac{1}{4}$ in., and $\frac{1}{8}$ in. firmer chisels; pair of wing compasses; hammer, screwdriver, marking gauge, mallet, try-square, and marking knife. Space is left also for other tools, such as files, mortise gauge, bevel, spokeshave, etc.

The quantity of material required for the single rack is as follows; back 5 ft. $1\frac{3}{4}$ in. by 1 ft. 3 in. by $\frac{7}{8}$ in.; top shelf 5 ft. $1\frac{3}{4}$ in. by $4\frac{1}{8}$ in. by $\frac{5}{8}$ in.; bottom shelf 2 ft. $4\frac{1}{2}$ in. by $4\frac{1}{8}$ in. by $\frac{5}{8}$ in.; middle shelf 1 ft. $10\frac{7}{8}$ in. by $4\frac{1}{8}$ in. by $\frac{5}{8}$ in.; two partitions 9 in. by 4 in. by $\frac{5}{8}$ in.; and two ends 1 ft. 3 in. by $4\frac{1}{4}$ in. by $\frac{7}{8}$ in. For the double rack this quantity will have to be doubled.

It will be noticed that the ends of the single rack just fit over the ends of the bench, to which they are secured by screws. The back should be first taken in hand, as it is the foundation upon which the rest is built. The top shelf is ploughed into this $\frac{1}{8}$ in. deep and is housed into the two ends, which in turn fit into a rebate cut $\frac{1}{4}$ in. deep into the ends of the back (*see* Fig. 90). The bottom shelf, on which the jack plane rests, is housed and screwed into the ends and dovetailed into the

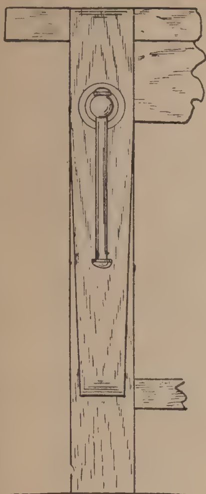


Fig. 75.

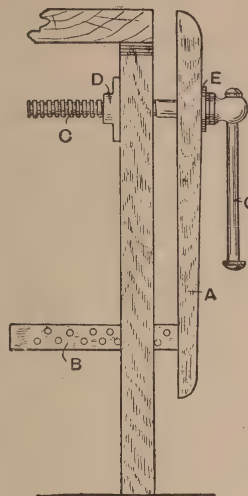


Fig. 76.

Figs. 75 and 76.—Front and Side Elevations of Front Vice

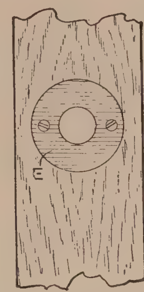


Fig. 81.—Front Elevation of Part of Jaw

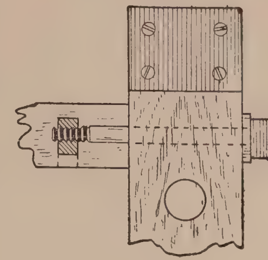


Fig. 82.—Elevation of Jaw of Back Vice

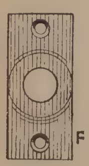


Fig. 80.—Front Elevation of Nut

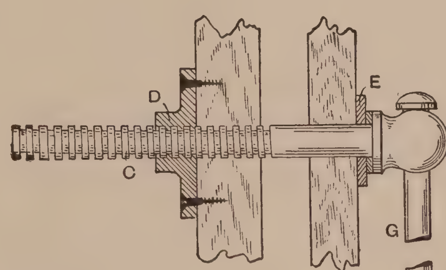


Fig. 79.—Section through Front Vice

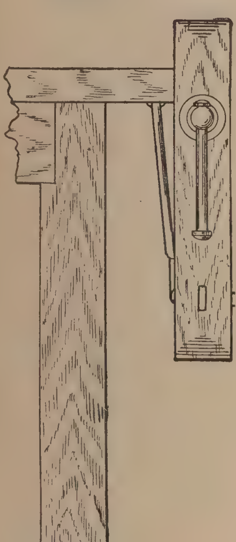


Fig. 77.

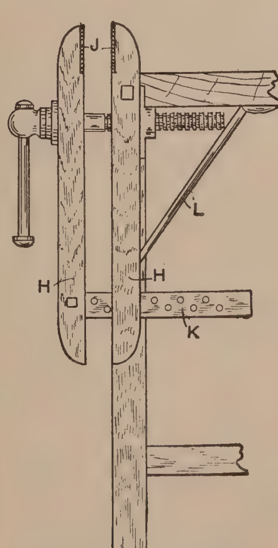


Fig. 78.

Figs. 77 and 78.—Front and Side Elevations of Back Vice

Fig. 83.—Side Elevation of Jaw of Back Vice

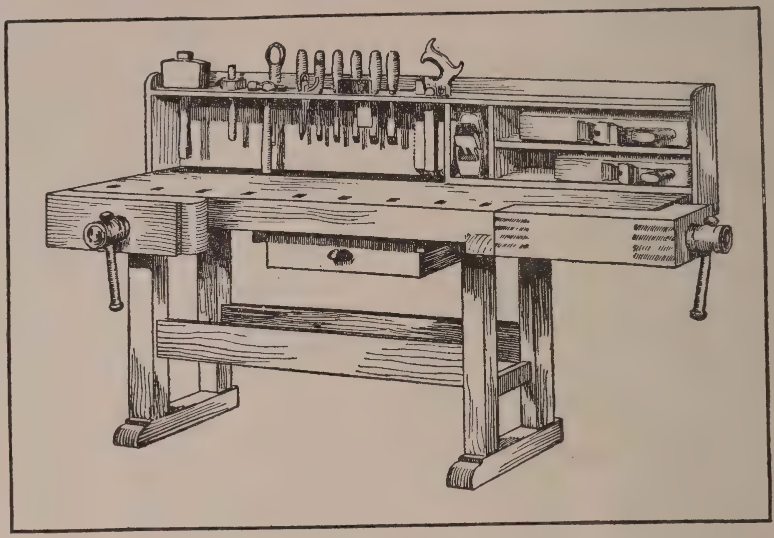


Fig. 84.—Tool Rack for Bench in Position

middle partition. This partition is also housed and screwed into the underside of the top shelf, and fastened to the back with screws. The middle shelf and the inner partition are housed together and are connected in the same way to the other pieces. Provision is made for the marking knife in the inside of the left-hand end, under the shelf, a metal staple being screwed on to receive it, as shown in Fig. 91.

The construction of the double rack is slightly different, as will be seen in Fig. 89. Here the back becomes a division

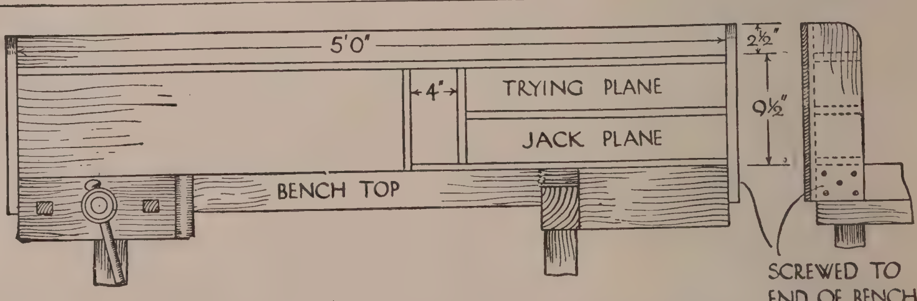


Fig. 85.—Front and End Elevations of Single Tool Rack

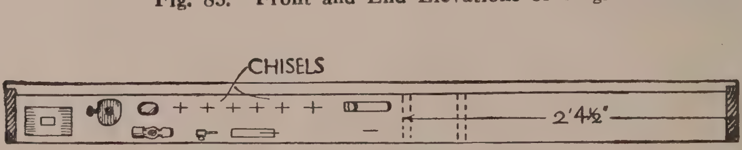


Fig. 86.—Plan of Single Tool Rack

Fig. 91.—Staple for carrying Marking Knife

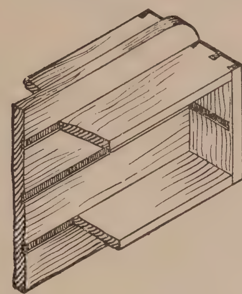


Fig. 88. — Details of Construction of Double Rack

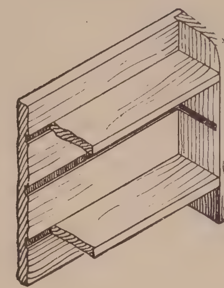


Fig. 90.—Details of Construction of Single Rack

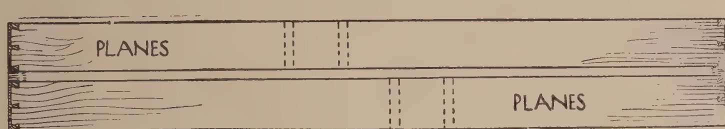


Fig. 89.—Plan ot Double Tool Rack

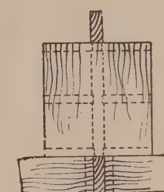


Fig. 87.—End Elevation of Double Rack

between the racks and goes through from top to bottom and is housed into the ends by means of plough grooves $\frac{1}{4}$ in. deep. In this case the ends are $8\frac{7}{8}$ in. wide, and the top and bottom shelves are lap dovetailed into them (Figs. 87, 88 and 89). Otherwise the construction is the same as for the single rack. It will be seen that the back of the double rack projects down between the backs of the bench wells (*see* Fig. 88). This arrangement enables the rack and the benches to be bolted or screwed together. The rack may be made in yellow deal, pine, or whitewood, and if varnished, it will not only look better but can be kept cleaner.

PORTABLE FLAP BENCH

The portable bench shown ready for use by Fig. 92 and folded by Fig. 93 is very suitable where a bench is required occasionally. Figs. 94 and 95 are front and end elevations of the bench. When the bench is not in use, the screw, screw cheek, and runner can be taken out, the legs folded to the wall, and the top and side folded and let down, as shown in Figs. 93 and 96. The construction is sc clearly shown in the illustrations that only the leading points need description.

A simple method of jointing the legs and rails is lap-dovetailing, which is described in an earlier section. The top should be at least $1\frac{1}{2}$ in. thick, and is formed of two boards jointed; to keep it true, it should be clamped and tenoned. The top should be hinged to the rail A, and the side of the bench hinged to the top as shown at B (Figs. 95 and 96), 3-in. butt hinges being used for this purpose.

The wall-piece C should first be firmly screwed to the rail of the top A. The legs should be hinged at the top to this piece, and also at the bottom to the strip D, which should be sufficiently thick to project from the wall to the thickness of the wall-piece C. The piece D can be attached to the skirting-board with a few screws. The wall-piece C, if against a lath-and-plaster partition, can

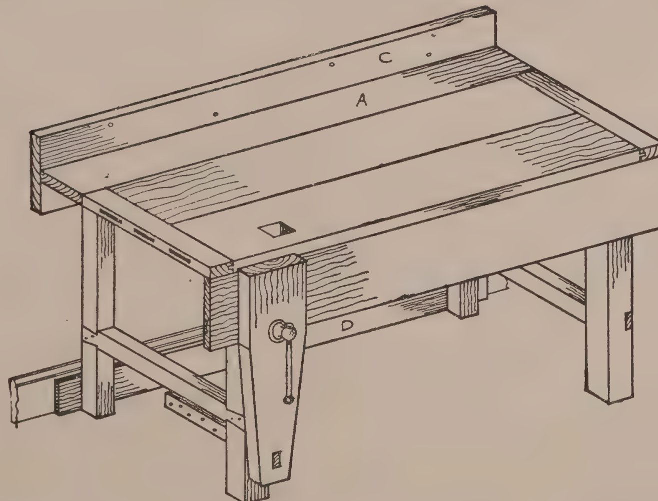


Fig. 92.—Portable Flap Bench

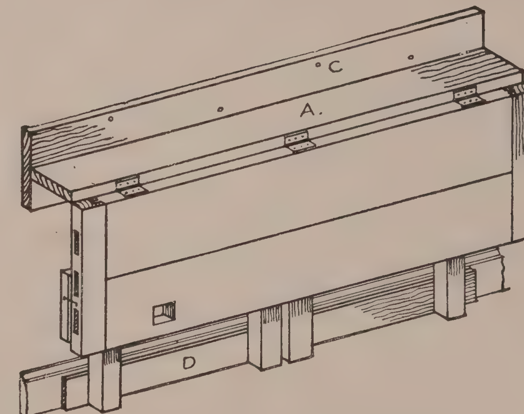


Fig. 93.—Flap Bench Folded

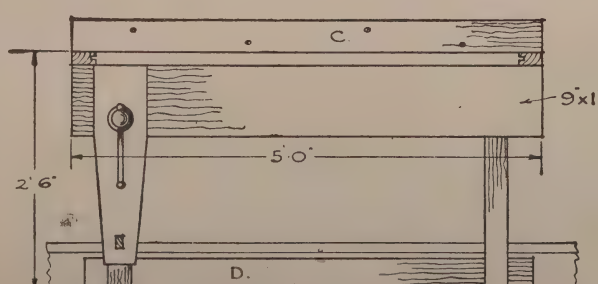


Fig. 94.—Front Elevation of Flap Bench

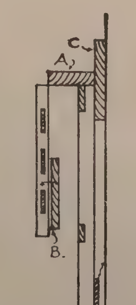


Fig. 96.—End Elevation showing Bench Folded

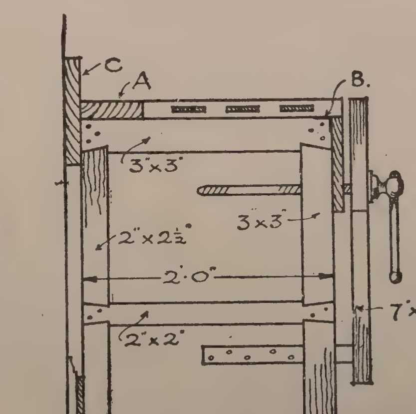


Fig. 95.—End Elevation of Flap Bench

be firmly and easily fixed to two or three of the studs of the partition with half a dozen screws. If it is against a brick wall, drill a few holes into the wall and drive in hardwood plugs ; or, better still, with a long fine bradawl probe the wall until the joints are found, and then with a steel chisel cut square holes about $\frac{3}{4}$ in. side and about 3 in. or 4 in. deep. These holes may then be fitted with hardwood plugs, into which screws are inserted through the wall-piece.

The fitting up of the screw, cheek, and runner (the last-named being of hardwood) will present no difficulty. The leg to which the screw is attached is of a larger size than the others. The side and top of the bench when folded up can be kept in position by a hook and eye as shown. A convenient form of bench stop will be one of the improved iron stops which require letting in.

This bench may be made additionally firm by inserting a few screws through the side into the legs, and through the top into the rails. To remove the bench, withdraw these screws.

BENCH FOR NAILING PICTURE FRAMES

Cramps are rarely, if ever, used by the professional picture framer, as the method would be too slow and costly. Instead, a special form of bench is used, as shown by Figs. 97 to 105.

On the average framer's bench there is fixed a block of hardwood with one edge shaped a true mitre, as shown at A (Fig. 97). Against this mitred block the first mitred length of moulding is placed with its outer edge lying on the bench. The adjacent length of moulding, which has been previously bored with a bradawl, is held firmly against the mitre of the first length on the bench. The bradawl (a 3-in. pattern-maker's) is inserted into the previously bored hole, and when the mitres are fair and match evenly, the awl is forced into the second moulding about $\frac{1}{4}$ in. to $\frac{1}{2}$ in. as a guide for the nail. The nails are special small round wire ones with very small heads. As a rule, one is sufficient in each corner, but before nailing the mitre is brushed with glue. The glue should not be brushed within $\frac{1}{4}$ in. of the front faces, because in nailing up the surplus glue would be squeezed out over the gilt, making it look unsightly, and wasting time required in cleaning it off. After the two pairs of mitres have been nailed up against the mitre stop A, a loose block B (Fig. 98) is inserted to form a square face or stop, against which the square corner of the frame is supported while the other two sides are joined up.

Sometimes a separate fixed square edge stop block is attached close to the mitred stop block shown in Fig. 97. These two blocks are all that are used by many framers. The method is quite elementary, and considerable care must be exercised to keep the upright piece in line with its fellow while nailing together. Also, it may be noticed, on referring to Fig. 98, that there is a tendency (in theory, at least) while nailing up the third and fourth corners for the brads at C to have a sheering strain placed on them, and at the same time the lower angle of the moulding to have its extreme point bruised against the square stop block. To overcome the first of these difficulties, a vertical fence about 1 ft. 4 in. high, and capable of sliding in or out to suit the varying sizes of frames, has been introduced. By its adoption, if the bottom length of moulding is close to the fence and the vertical pieces resting against the fence also, the operator can be certain that the frame will be nailed up and lie flat when finished. This will also save the trouble of looking to see if each length is being held vertically while joining up the frame.

The fence is shown in use in two positions in Figs. 97 and 98 ; an end view is given in Fig. 99, and the plan is shown by Fig. 100. The block is locked in the desired position by either a winged nut or, for speed, an eccentric lever acting on the T-shaped bolt in the groove formed in the bench. A guide fillet is also attached to the fence, and slides in the groove. The fillet is shown by dotted

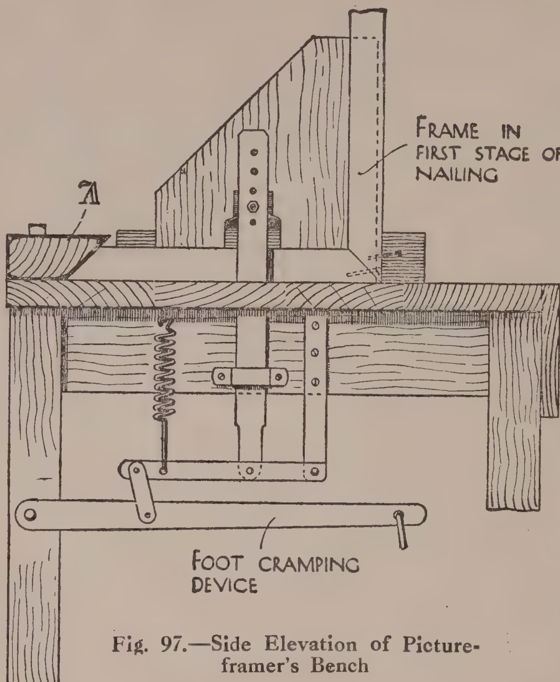


Fig. 97.—Side Elevation of Picture-framer's Bench

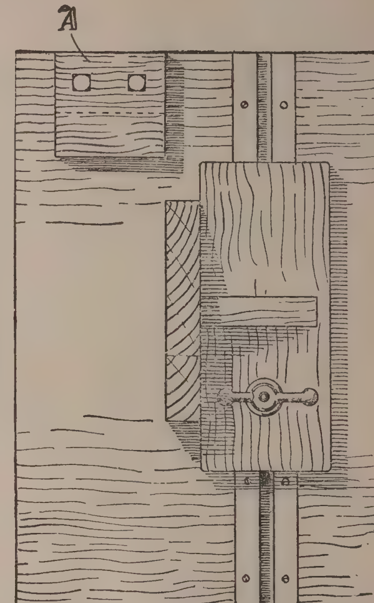


Fig. 100.—Plan of Picture-framer's Bench

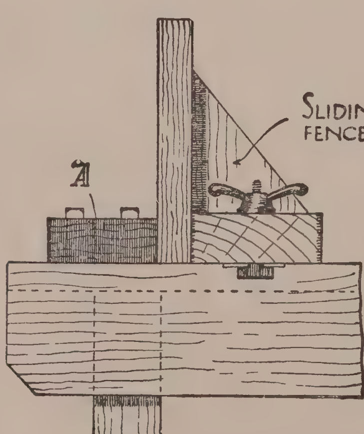


Fig. 99.—End Elevation of Sliding Fence

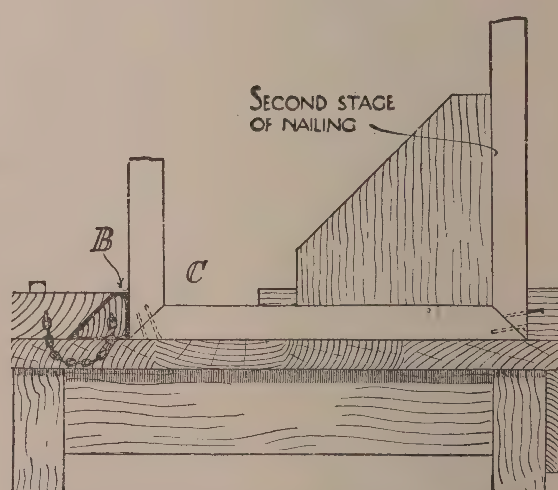


Fig. 98.—Showing Picture Frame in Second Position for Nailing

lines in Fig. 100. By the adoption of the vertical cramping bar actuated by a foot lever, much of the strain of hammering is taken off the stop blocks, and the partial section is given in Fig. 101. The foot lever engages in a fine-toothed rack similar to the brake handle on horse-drawn vehicles ; thus the foot is relieved from

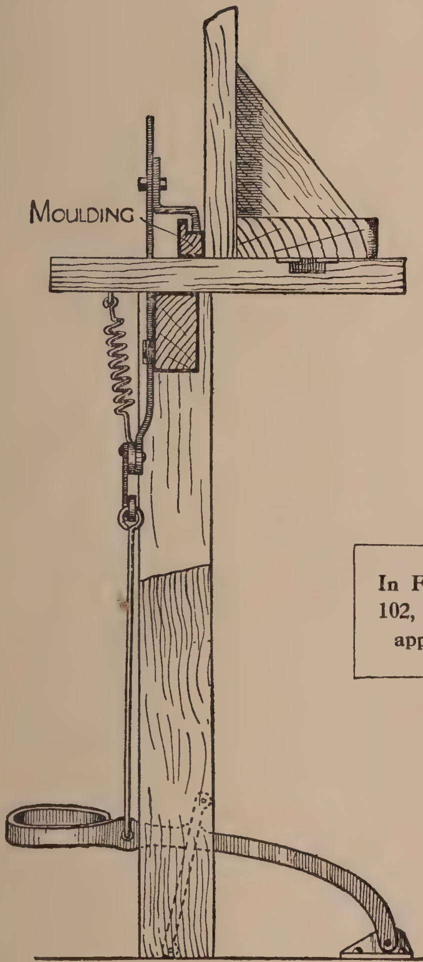


Fig. 101.—End Elevation of Foot Cramping Device, showing Moulding Held in Position

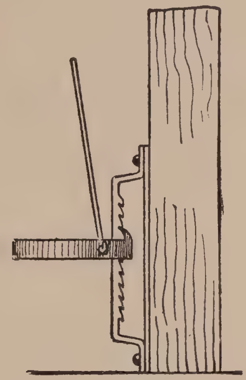


Fig. 102.—Rack for Retaining Foot Lever ; Lever is Released by a Downwards and Forwards Pressure of the Operator's Foot

In Figs. 101 and 102, 1 in. = 1 ft. approximately

Fig. 103.—Shaped Block for Irregular Mouldings; the Block Clears the Foliated Parts

danger of damage or sheering previously mentioned is greatly minimised.

A side view of the clamping arrangement with its adjustable clamping grip and helical spring for quick lift or release is shown in Fig. 97. The end view in pressure as long as desired. To release, it is only necessary to press down and also towards the post or away from the rack (*see* Fig. 102), when the spring will cause the whole arrangement to rise up quickly. The iron work in connection

with the foot cramping gear is simple to make, and is within the capabilities of any blacksmith.

When dealing with fancy-edge moulding, it will be necessary to make parallel blocks of wood to suit the shape of the particular moulding. Fig. 103 shows a block suitable for florentine moulding. The block clears the outer foliated part, and supports the inner plain edges only.

Details of the T-groove for the sliding fence are shown in Figs. 104 and 105. The bench is grooved about $1\frac{1}{4}$ in. wide by $\frac{3}{4}$ in. deep to receive the head of the T-bolt. On each side of the centre groove, rebates are formed to receive the $\frac{3}{16}$-in. by $1\frac{1}{4}$-in. strips of metal attached to the bench with stout countersunk screws. A quick clamping action is effected by the eccentric lever shown in Fig. 105. When the handle is in a vertical position, it lifts the T-bolt tightly against the metal plates, because of the eccentricity of the pin in the lever. Adjustment is made by inserting washers of varying thickness until the right tension is obtained.

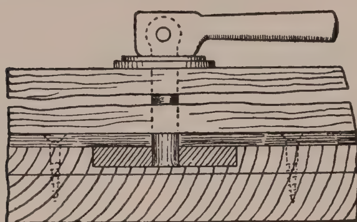


Fig. 104.

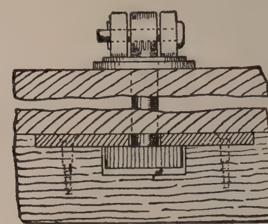


Fig. 105.

Figs. 104 and 105.—Two Elevations showing Details of Cramping Lever and Bolt of Picture-framer's Bench

Garden Carpentry

SEED DRILLS

A HOE is commonly used to make the drills for seeds, but the correct implement is a seed drill as shown by Figs. 1 and 2.

It consists of a block of wood, into which is mortised a long shaft. The shaft is made, preferably, out of a hayfork shaft, which, being of ash or hickory, is strong and pliant, and capable of withstanding hard blows and shocks. The block of wood is made of birch, ash, oak, or sycamore. It is chamfered at the back as shown, and is rounded at the top and pointed at its lower end. Fig. 3 gives a separate inside view of the head, showing how it can be marked to get the varying depths for seeds. The joint is a round mortise. The shaft is shouldered, as shown in Fig. 1, and a wedge is driven in at the back.

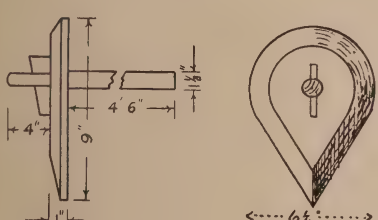


Fig. 1. Fig. 2.

Figs. 1 and 2.—Single Seed Drills

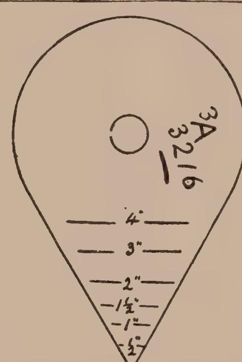


Fig. 3.—Front Elevation of Drill

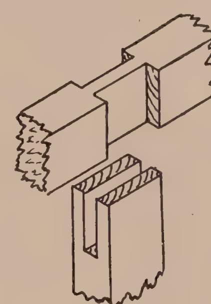


Fig. 7.—Detail of Bridle Joint

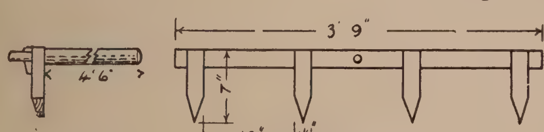


Fig. 4. Fig. 5.

Figs. 4 and 5.—Side and Front Elevations of Onion Drill

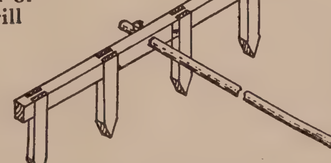


Fig. 6.—Onion Drill

Figs. 4, 5, 6 and 7 show a drill for onion seeds which require parallel rows. The shaft again is best made from a hayfork

shaft or a piece of ash, and is fixed to the cross-piece in the same way as for the drill. The teeth or drills are fixed to the cross-piece by means of a bridle joint, shown by Fig. 7. All these joints can be glued if the drill is afterwards to be painted or varnished, but if not it is better to use white-lead paint in the joint and to fasten with oak pins.

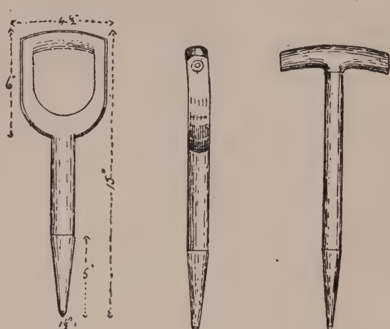


Fig. 8. Fig. 9. Fig. 10.

Figs. 8, 9 and 10.—Dibbers Made from Spade-shaft

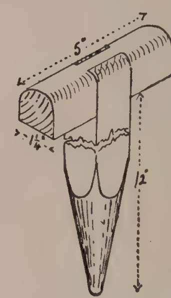


Fig. 11.—Dibber Made from Two Pieces of Wood

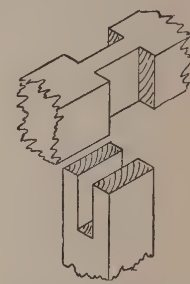


Fig. 12.—Details of Bridle Joint

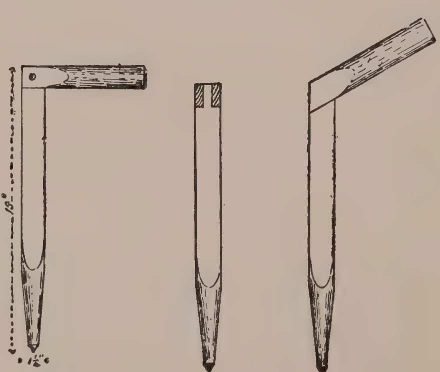


Fig. 13. Fig. 14. Fig. 15. Fig. 16

Figs. 13, 14, 15 and 16.—Side and Front Elevations of French Dibbers

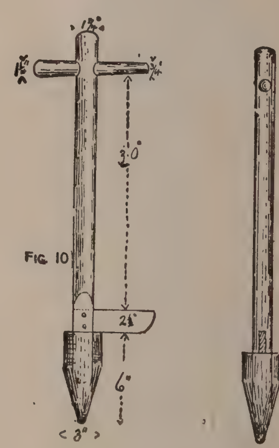


Fig. 17. Fig. 18.

Figs. 17 and 18.—Side and Fron Elevations of Potato Dibber

GARDEN DIBBERS

These are sometimes known as dibbles. They are used for making the hole in the ground when planting out young seedlings.

Figs. 8 and 9 give front and side elevations of a dibber made from the broken shaft of a spade. The measurements are given. If a broken shaft is not available, then a piece of birch, ash, beech, or sycamore can be used to make one similar. Some gardeners point the dibber with sheet iron or other metal, to prevent the point becoming worn, or rotted by alternating damp and dryness. A spade handle of the type shown in Fig. 10 is also very suitable. A dibber made from

material whose section is $1\frac{1}{4}$ in. by $1\frac{1}{4}$ in. finished size is shown by Fig. 11. The joint between the handle and the shaft is sometimes driven into the end to prevent undue wearing, although this rusts, and in time causes rotting of the wood. The

Fig. 19.—Seed Marker Made from Lath

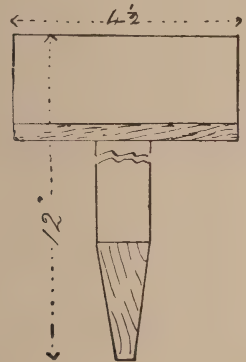


Fig. 25.—Front Elevation of Marker with Oblique Top

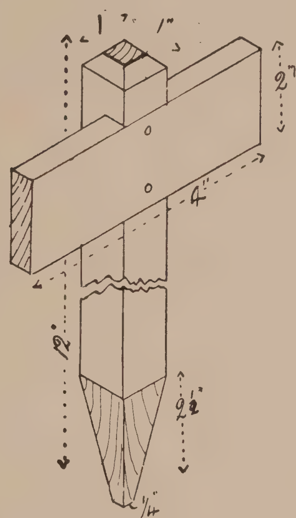


Fig. 21.—Marker with Cross-piece

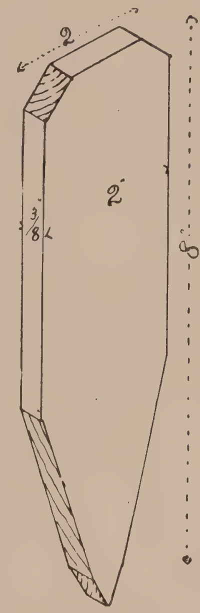


Fig. 20.—Simple Marker

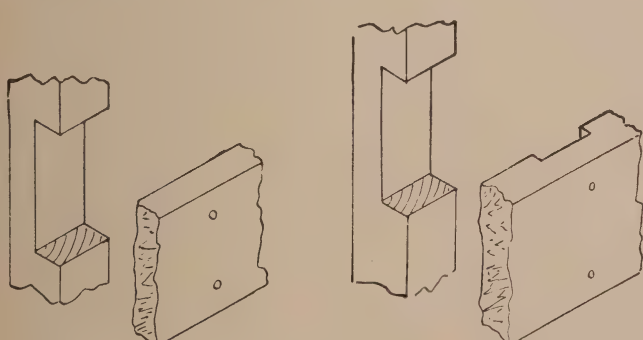


Fig. 22.

Fig. 23.

Figs. 22 and 23.—Details of Joints

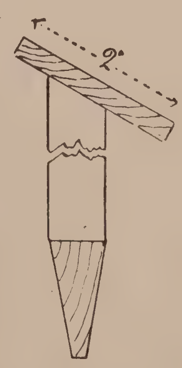


Fig. 24.—Side Elevation of Marker with Oblique Top

is known as a bridle joint, and is shown separately by Fig. 12. The pointed position is rounded and tapered. It is better not to taper it to a point, but to let the end be about $\frac{1}{4}$ in. A boot hobnail joint should be fixed with white-lead, and not glue. The top of the handle is rounded to fit the hand.

A better form of dibber is shown by Figs. 13 and 14. The handle only extends

on one side of the shaft, and enables the whole hand to grasp it. It also is rounded in both shaft and handle. The joint is a dovetailed bridle joint. Figs. 15 and 16 show a still better form. This is similar to Fig. 13, but it has its handle fixed to the shaft at an obtuse angle. This enables the handle to be grasped more easily, as will be realised when a dibber like this is once used. An angle bridle or an angle dovetail bridle may be used as the joint, as in Figs. 14 and 16.

It is not necessary that these dibbers should be short, so that too much back bending is induced. They may have longer shafts, long enough to make the holes without stooping too far. Figs. 17 and 18 give views of a potato dibber such as is often used to plant potatoes. The base is made out to about 3 in. in diameter, and the shaft is about $1\frac{3}{4}$ in. It is long enough to work without stooping, and the side step is for resting the foot on to drive the dibber into the soil, and at the same time guide its distance into the ground to get the correct depth for the potato. To make it, paint and screw to a central shaft four pieces of $\frac{3}{4}$-in. stuff to make the lower end thicker. Then round both the shaft and head, and point the head. Bore a hole near the top of the shaft to receive the handle. Mortise, before rounding, the foot-rest into the shaft, and paint and screw tightly.

SEED MARKERS

Often a piece of stick, a piece of broken plaster lath, or a twig is used for marking the resting-place of seeds. A little time spent in making some presentable seed markers is well worth while, and these, with care and a little attention, will last for more than one season.

Fig. 19 shows a seed marker that is only a slip of wood, but it has a little handicraft in it. Seed markers like this can be made from prepared trellis laths. They are cut to length, and pointed with a chisel, and the top end pared end-grainwise with a chisel also. Do not cut the point dead sharp, but leave it about $\frac{1}{8}$ in. or $\frac{3}{16}$ in. wide. A hole drilled through each with a centre bit will enable them to be tied together and hung up when not in use. Fig. 20 shows a wider marker. This is thicker too, and enables more particulars regarding the plant to be placed on it. It is planed up, set out, and then cut by means of a chisel.

Fig. 21 shows a seed marker that is made of two pieces of wood. The joint between the two can be a housed joint, as shown by Fig. 22, or a half-lap, as shown by Fig. 23 ; in the latter case wood is taken out of each piece. The cross-piece is screwed to the upright, after well painting the joint. The upright can be any length, and to prevent undue stooping a length of about 2 ft. would be very convenient.

Another type is that shown by Figs. 24 and 25. This is to meet the need spoken of already. The board is fixed at an angle to the upright, so that the name may be presented at right angles to the line of vision. It is not necessary to do more than nail the name-board to the upright, painting the joint first to prevent as far as possible decay due to weather. All the boards can be made to any shape desirable.

All the markers should be painted with a thin coat of white or light-coloured paint. This keeps them from perishing too soon by alternate dry and wet, and also enables the name of the seed to be written on the more easily.

Strips of tin can be used as cross-pieces instead of wood. Painted black and lettered white, they are quite good. It is well to "tin" the cut edges of the tinplate to prevent the rusting of the mild steel which forms the base of the tinplate.

SEED GUARD

A most useful guard for seeds and young plants, which are often destroyed by birds when left without any protection, is shown by Fig. 26. The guard consists of two wood ends fixed in the desired position with stakes, the guard being formed with twine wound round the heads of nails which are driven into the edges of the wood ends at frequent intervals. The ends for the guard are shown in Figs. 27

and 28. They are cut to the dimensions given in Fig. 28, from wood $\frac{3}{4}$ in. or 1 in. thick, and two stakes are nailed across each end, the stakes being about $1\frac{1}{2}$ in. wide and pointed at the ends. Nails are driven into the edges of the ends at frequent intervals, as shown in Fig. 28, and the guard string wound round the nails.

Wood from old boxes and packing-cases could be used very largely in constructing these pieces of garden equipment. Too much attention cannot be paid to painting any of the objects described, and special care should be taken to see that all the joints are well painted before fixing.

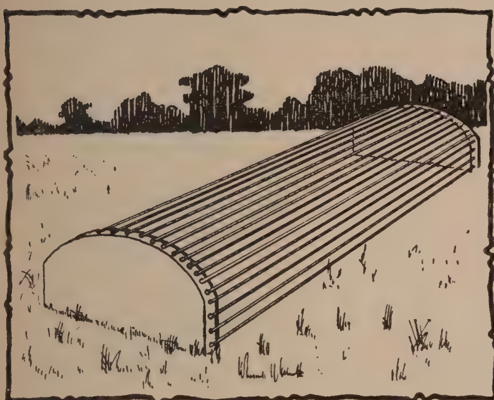


Fig. 26.—Seed Guard

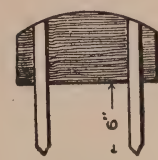


Fig. 27.

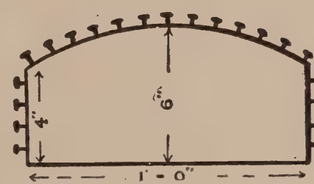


Fig. 28.

Figs. 27 and 28.—Ends for Seed Guard

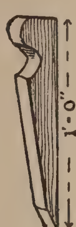


Fig. 30.—Ground Stake

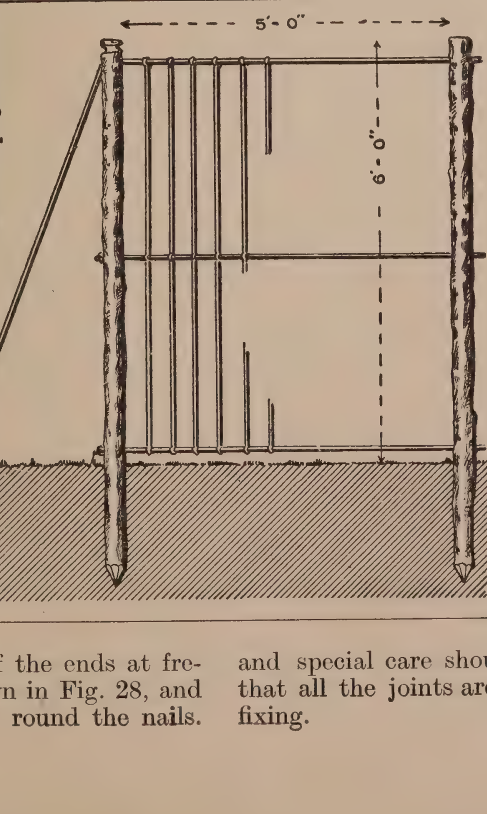


Fig. 29.—Trailer for Beans or Peas

TRAILER

A trailer for beans and peas is shown by Fig. 29, and with the aid of this trailer the usual bean and pea sticks can be dispensed with; when once made it will last for years. It consists of wood poles driven into the ground at intervals. Fairly stout wires are fitted across the top, in the middle, and at the bottom of the poles, these wires being connected by other upright wires or strings up which the beans and peas climb. The end poles are secured with stays and stakes as shown.

The poles for the trailer should be 8 ft. long by $2\frac{1}{2}$ in. or 3 in. in section, driven into the ground about 2 ft. The horizontal wires fit through holes in the poles, and are knotted or twisted to keep them in place. The top wire could be continued to the ground, and fixed with a stake as shown in Fig. 29. Side stays of wire should also be arranged between the tops of the end posts and the ground, being secured with wood stakes. A suitable wood stake is shown by Fig. 30. The upright wires or strings should be arranged at intervals of 3 in., being twisted or tied to the horizontal wires.

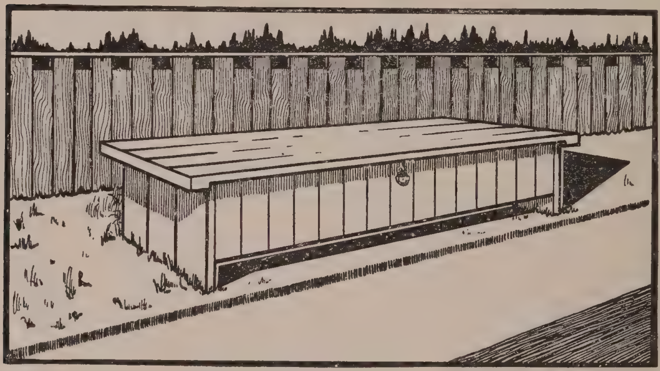


Fig. 31.—Garden Tool-box

GARDEN TOOL-BOX

A tool-box is a great convenience in a garden, and even the most enthusiastic gardener will welcome the seat formed by the top of the tool-box. The tool-box and seat shown by Fig. 31 is of fairly simple construction, and considering its usefulness the cost is trifling. Figs. 32, 33, and 34 show elevation, end view and plan.

It is proposed that ordinary deal should be used, the boards being grooved and tongued together; but there is no reason why any ordinary boards which one may have on hand should not be used if desired. Suitable dimensions are given in the illustrations, but they may be altered as desired, as the size to which the box is made will depend on the size and number of tools which it is intended to hold. It will be noticed that the ends of the box are sunk into the ground, but this is optional, the object being to prevent the box being moved.

There are two ends made, as shown by Fig. 36, consisting of boards cut 2 ft. 5 in. long, and made up to 1 ft. 6 in. wide. The boards are held together with battens A and B, which are 1 ft. 3 in. long by 3 in. deep by 1 in. thick, nailed on the inside in the positions shown. A batten 1 ft. 6 in. long by 2 in. deep by 1 in. thick is also nailed across the bottom edge on the outside of each end. The ends are connected by four rails C (*see* Fig. 35), which are 3 in. deep by 1 in. thick in section. These rails are framed into the ends in the positions shown, the inner faces being kept tight against the ends of the battens A and B, so that the outer faces will stand $\frac{1}{2}$ in. in from the edges of the ends. It will be best to tenon the rails C into the ends, and a joint, as shown in Fig. 37, may be used, whilst mortises are cut in the ends, as shown in Fig. 36. To strengthen the joints between the rails and the ends, angle-plates could be fitted in the corners, as shown in Figs. 35 and 38. The plates could be of iron 3 in. wide by $\frac{3}{16}$ in. thick, and may be about 3 in. long each way, each being fixed with four screws.

The bottom may be covered with $\frac{1}{2}$-in.

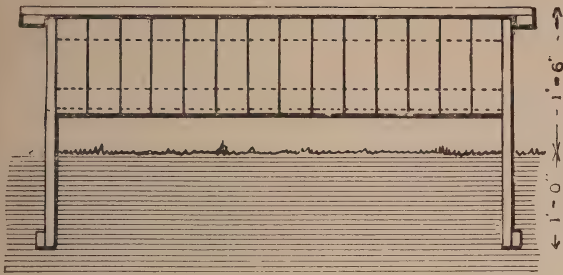


Fig. 32.

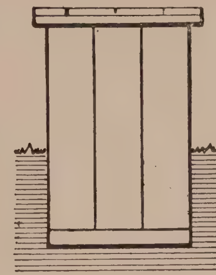


Fig. 33.

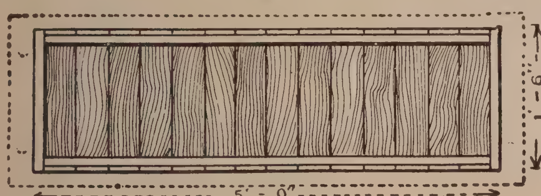


Fig. 34.

Figs. 32, 33 and 34.—Front and End Elevations and Plan of Garden Tool-box

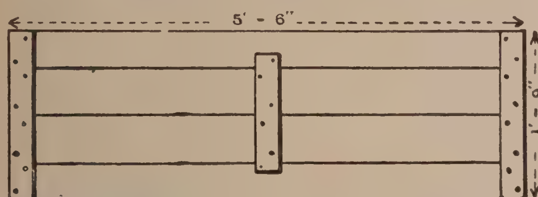


Fig. 39.—Top of Garden Tool-box

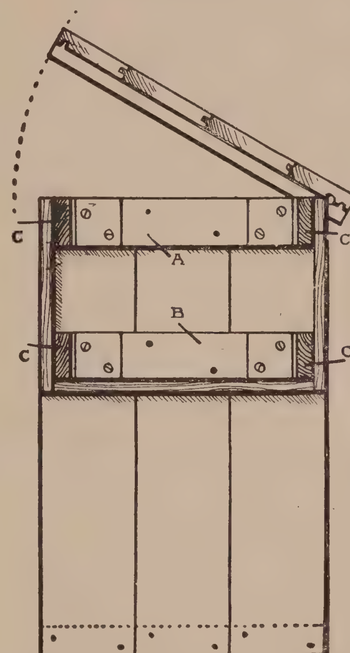


Fig. 35.—End Elevation of Tool-box showing Construction

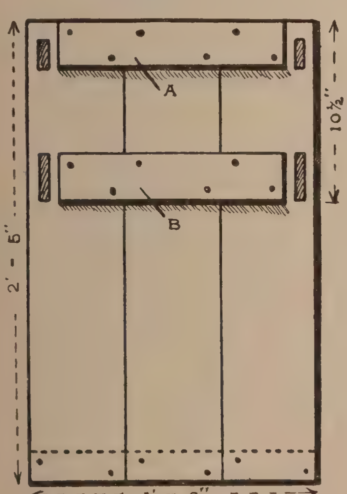


Fig. 36.—Details of Ends of Tool-box

Fig. 40.—Grooving in Underside of Top

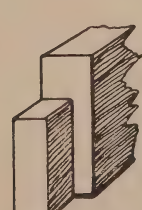


Fig. 37.—Rail Joint

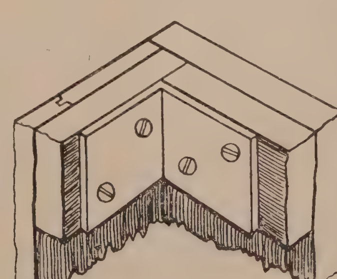


Fig. 38.—Corner Construction showing Angle-plate Fitted

grooved-and-tongued matchboards, fixed with the joints running from front to back, as shown in Fig. 34, and nailed to the bottom rails C. The front and back of the box may be covered with similar boards nailed to the faces of the rails C, as shown

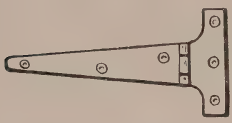


Fig. 41.—Hinge for Top of Tool-box

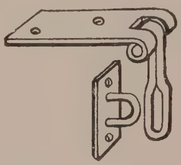


Fig. 42.—Hasp and Staple

in Figs. 32 and 35. The cover of the box should be formed from 1-in. grooved-and-tongued matchboarding, and should be made to overhang 3 in. at the ends and $1\frac{1}{2}$ in. at the front and back (Fig. 39). If small grooves are cut along the front and back edges of the underneath side of the cover, as shown in Fig. 40, this will prevent water from running back under the cover. The cover is held together with battens 3 in. by 1 in. in section, two being fixed across the ends and one in the middle, the latter being cut so that it will fit between the sides of the box. The cover is hinged at the back with a pair of T-hinges similar to that shown by Fig. 41, and for fastening the cover a hasp and staple similar to that shown by Fig. 42, which may be secured with a padlock, will be very suitable. To make the cover quite watertight it will be well to cover it with a piece of canvas tacked round the edges, and well painted underneath.

In fixing the seat, the earth must be removed so that the ends may be sunk into the ground. The portions sunk into the ground should be tarred or coated with thick paint, and when the seat has been set level the earth should be well rammed in. Some would, perhaps, prefer to set the ends in concrete. It is needless to add that the tool-box and seat would be improved by an annual coating of paint, the first coat consisting of red lead, oil and a large proportion of turpentine, the later coats containing white lead, boiled oil and less turpentine.

COMBINED GARDEN SEAT AND TOOL-BOX

A seat which also provides a lock-up for tools is shown in part front elevation, end elevation and part plans by Figs. 43, 44, and 45.

The carcass should preferably be made from 1-in. tongued-and-grooved flooring; but any odd timber or packing-cases which may be available could be utilised. The height, length, and width, inside, should be decided by the space required for the spade, rake, hoes, fork, waterpot, etc., which have to be accommodated. The dimensions given will probably be found suitable for average needs. The timber should be cut to size, and given a coat of priming before assembly. The boards forming the sides and the ends should be arranged with the tongues uppermost and grooves beneath, so as to prevent the entry of any moisture. The joints should "break" at the corners, which should be grooved as shown, and the sides secured to the ends with 3-in. cut nails driven askew. The bottom should be secured with $2\frac{1}{2}$-in. No. 10 screws.

When assembling, give each joint a coat of white-lead and red-lead in boiled oil, and any cracks or defective joints should be stopped with the same mixture stiffened with putty. The underside of the bottom, the cross-bearers of quartering, the foot-rest laths, and the buried portion of the ground stakes should be treated with two coats of carbolineum or creosote.

The top, or seat, should be of good sound stuff $1\frac{1}{4}$ in. thick, with tongued-and-grooved joints well leaded as above described, and braced with three battens screwed on the inner side. The front edge should have a nosing deep enough to carry off any water. The arm supports serve to stiffen the seat and support the back, the rails of which are of flooring with front edges rounded. They are screwed to uprights of 2-in. by $1\frac{1}{2}$-in. stuff tenoned into the lid, the centre one being also bracketed at the back. The arms themselves need not necessarily be more than about 3 in. wide.

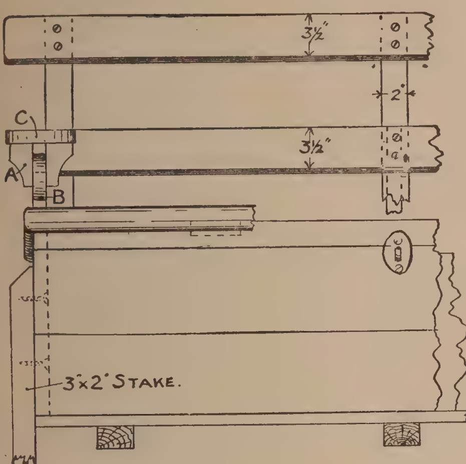


Fig. 43.

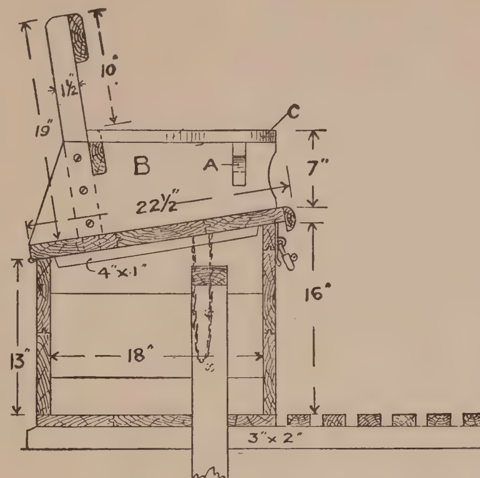


Fig. 44.

Figs. 43, 44 and 45.—Part Front Elevation, End Elevation and Part Plan of Garden Seat and Tool-box

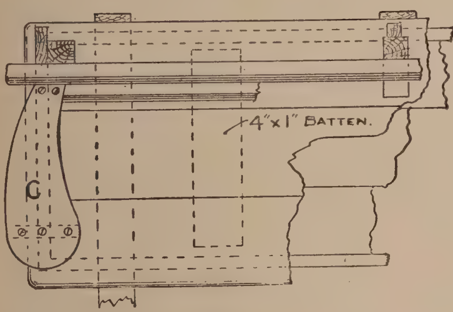


Fig. 45.

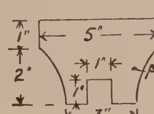


Fig. 48.—Bracket for Arm-rest

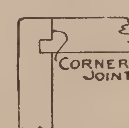


Fig. 50.—Detail of Corner Joint of Box

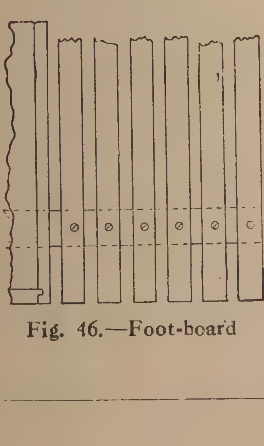


Fig. 46.—Foot-board

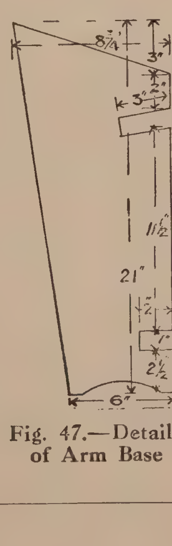


Fig. 47.—Details of Arm Base

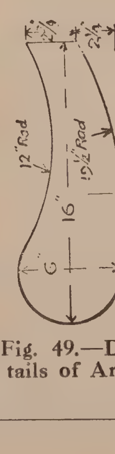


Fig. 49.—Details of Arm

The hinges, of the box type, must be set back to allow the seat to overhang about $\frac{1}{2}$ in. The top can be fastened with a stout staple padlock and hasp, and prevented from falling back when opened by a suitable length of chain or sash-cord, attached as shown in Fig. 44. Details of the joints, etc., are shown in Figs. 47 to 50. Fig. 47 gives the dimensions for base of the arms; Fig. 48 is the supporting bracket for the arm-rest; Fig. 49 and Fig. 50 is the corner joint of the tool-box. The construction of the foot-board is shown in Fig. 46.

Unauthorised removal is prevented by stout stakes driven into the ground, one at each end of the box, which is screwed to them from inside. The entire seat and box should, when completed, be given three coats of good oil paint, the last one being improved by the addition of a little copal varnish well mixed in.

GARDEN SEAT WITH CANOPY

The seat shown by Fig. 51 folds into small compass when not in use, and is very light. It has a canvas canopy, which, besides being useful in a strong sun, also acts as a draught screen. Figs 52 and 53 show an elevation and section of the seat respectively, and also give the principal dimensions to which it may be made, while Figs. 54 to 57 show details of the construction. In making the seat, first prepare a full-size section (Fig. 53).

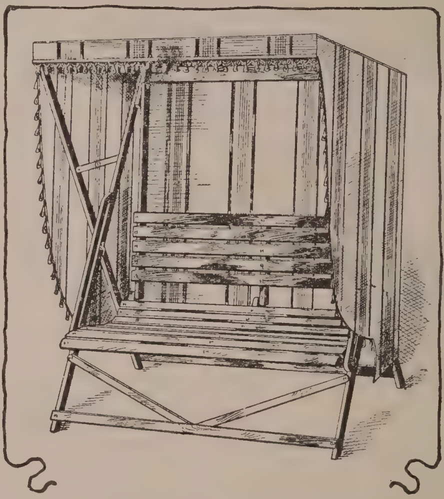


Fig. 51.—Garden Seat with Canopy

The legs A (Fig. 53) are 6 ft. 9 in. long, and the legs B are 6 ft. long, each being $1\frac{1}{2}$ in. wide by 1 in. thick. The top cross rails C, which connect the top ends of each pair of legs, are 3 in. by $\frac{3}{4}$ in. in section, and the bottom cross rails D are 2 in. by $\frac{3}{4}$ in. These cross rails are screwed in position, the top rails being level with the top ends of the legs, while the bottom rails are fixed 2 in. up from the bottom ends. Each pair of legs is kept rigid by fixing two diagonal rails E to them, as shown in Figs. 51 and 52. These rails are $1\frac{1}{4}$ in. by $\frac{1}{2}$ in. in section, and are fixed with screws. Fig. 54 shows the method by which the legs are hinged together. A $\frac{3}{8}$-in. rivet passes through the legs, iron washers are fitted under the heads of the rivet, and a $\frac{1}{4}$-in. washer is placed between the legs. The legs are hinged so that when opened out they correspond with the dimensions given in Fig. 53. A rule joint G is used for keeping the legs in position when open, and this is made from two pieces of $\frac{3}{4}$-in. by $\frac{1}{8}$-in. mild steel, riveted in the centre, and screwed to each leg (Fig. 53).

The back rails H are $1\frac{1}{2}$ in. by 1 in. in section, and they are hinged at the top to the legs B with rivets, as shown in Fig. 55. A block J, which is 6 in. long by $1\frac{1}{2}$ in. wide by $1\frac{1}{4}$ in. thick, is screwed to the top end of the legs, and a $\frac{1}{4}$-in. washer is placed between each block and the back rail. The seat rails K, which are three in number, are $1\frac{1}{2}$ in. deep by 1 in. wide, and are shaped as shown in Fig. 53. The end seat rails are hinged to the back rails H, while the middle seat rail is hinged to the middle back rail L (*see* Fig. 52), which should be of a similar section as the rails H.

Two bolts similar to that shown in Figs. 56 and 57 are fitted to the end seat rails, and these slide in the slot rails M. The bolts are $\frac{1}{2}$ in. in diameter; a $\frac{1}{4}$-in. washer is fitted in the centre, while the square portion which fits into the seat rail is $\frac{3}{8}$ in. square, and the end is screwed and fitted with a nut and washer for fastening

purposes. The slot rails M are $1\frac{1}{2}$ in. by 1 in. at the ends, and are shaped out where the slot is cut to 1 in. square. The rails should be long enough to allow the seat to fold, and they are fixed to the legs B with screws at each end. The seat battens are eight in number, and the five back battens, which are each 2 in. wide by $\frac{3}{4}$ in. thick, are fixed in position with screws.

The canopy covering should be of a light striped tent duck. For the back, top, and overhanging portion at the front two widths of material will no doubt have to be employed. The shaped sides are cut, and the whole is strongly sewn together round the edges, and ornamented with lace.

SEAT ROUND A TREE

There is no more desirable position for a seat in the open air than under the spreading foliage of a large tree. The drawings (Figs. 58 to 62) show a simple method of fitting up a suitable bench with the minimum of labour. The sizes must depend entirely on the tree it is intended to encircle, and the dimensions given varied accordingly; but the principle involved will remain exactly the same.

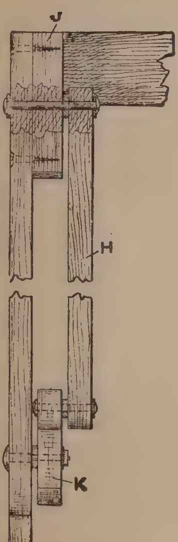


Fig. 55.—Details of Construction of Garden Seat

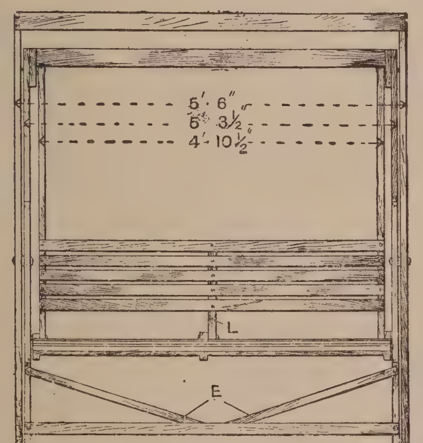


Fig. 52.

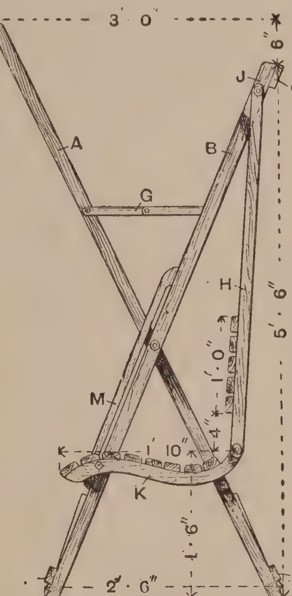


Fig. 53.

Figs. 52 and 53.—Front Elevation and Section of Garden Seat with Canopy

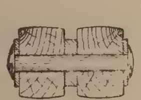


Fig. 54.—Method of Hinging Legs

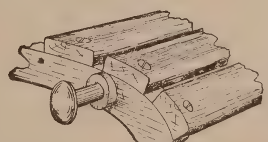


Fig. 57.—Bolt for Rail Slot Fixed

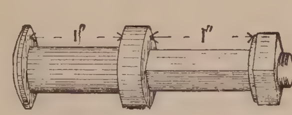


Fig. 56.—Bolt for Rail Slot

First of all the surface immediately round the base of the trunk should be made up approximately level, and a number of uprights bedded firmly in the ground by means of long tarred ends. (Fig. 61). They need to stand about 14 in. or 15 in. high, and may be of any reasonable size from 2 in. by 2 in. upwards, or unwrought sections of stout branches might be employed. They are set out, avoiding any roots, in the positions indicated by the eight small squares marked with crosses in Fig. 60, and carefully arranged in order to see that proper alignment is secured, and that all the tops are as nearly as practicable dead level.

Horizontal bearers as A, B, C, and D in the same figure, two of which are 5 ft. 9 in. and the other two 2 ft. 10 in. long, and each about 2 in. by $1\frac{1}{2}$ in., with ends rounded or splayed, as in Fig. 62, are then spiked strongly down to the uprights, and will afford a level surface on which to nail a series of battens, say $1\frac{1}{2}$ in. by $\frac{3}{4}$ in. or thereabouts, spaced out with not more than $\frac{1}{2}$-in. intervals between. These battens should be rounded or at least chamfered along their upper edges, and nailed once only over each bearer. They should be cut to fit as closely as possible to the outline of the tree where they butt against it, and the outer ends had better be left a little longer than necessary, and sawn off to the exact outline after the whole series has been fixed in position. It is wise to make such seats very slightly sloping inwards for comfort and drainage purposes.

Fig. 58.—Seat Round Tree

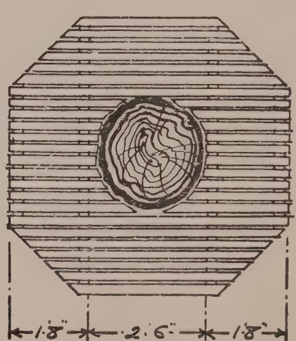


Fig. 59.—Plan of Top of Seat

Fig. 61.—Elevation of Side Parallel to Top Battens

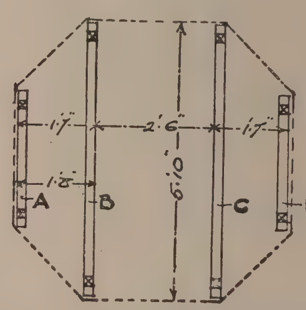


Fig. 60.—Plan showing Position of Uprights and Bearers

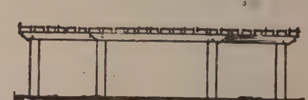


Fig. 62.—Elevation of Side Parallel to Bearers Under Battens

GARDEN SEAT OF MODERN DESIGN

A substantially constructed seat, quite modern in style and calculated to stand any amount of exposure to the weather, is shown in the perspective sketch Fig. 63. It would look extremely well painted white, or it could have some more serviceable finish. A width of 5 ft. between the arms as drawn will probably be sufficient; but this might be increased if desired, provided that a central support is added. With long, and shaped to a slightly segmental outline at the head, while the front ones are 1 ft. $11\frac{1}{4}$ in., with $1\frac{1}{2}$ in. extra for a tenon as dotted at A (Fig. 69), where a length of $4\frac{1}{2}$ in. is shown round-turned to a quaint stumpy outline. Each front leg is connected to the one behind by a $2\frac{3}{4}$-in. square rail as at B (Fig. 65) 3 in. above the ground, showing 1 ft. 3 in. long, tenoned and secured with oak pegs at the ends, as are all the joints in the job. A central rail is similarly fixed between these short ones from one end to the other C (Fig. 64)

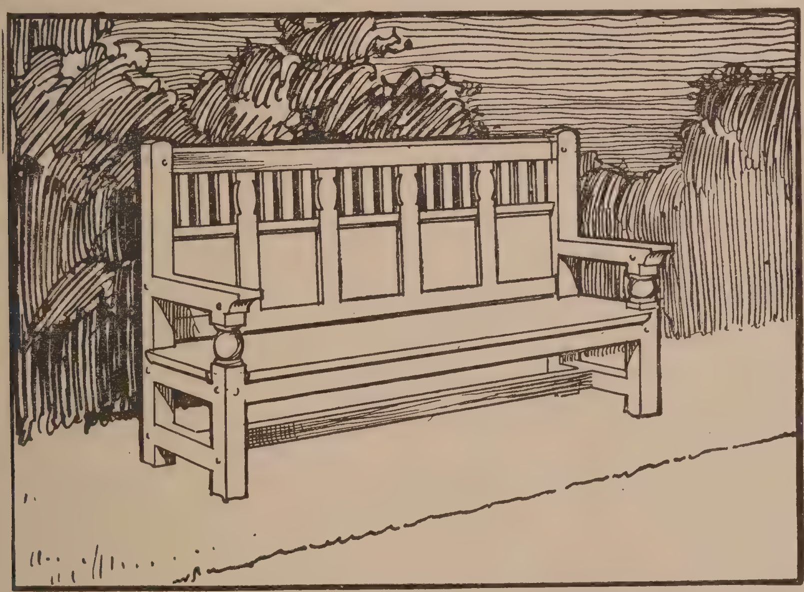


Fig. 63.—Garden Seat of Modern Design

reference to any simplification in the work the stuff used might be a trifle lighter in section, although the design depends for success largely on the use of fairly large parts; but the four shaped uprights shown in the sketch might be kept plain, and the turning to the front legs could be omitted. The seat also, instead of being made up all in one piece, could be composed of narrow battens with rounded edges and spaces between.

The seat consists of four vertical legs each $2\frac{3}{4}$ in. square, shown at the outer corners of the half-plans in Figs. 66 and 67. The back legs are each 3 ft. 8 in. and D (Fig. 66), and might be $2\frac{3}{4}$ in. by only $1\frac{1}{2}$ in. wide. With its bottom edge 1 ft. $\frac{1}{2}$ in. up from the ground, another $2\frac{3}{4}$-in. rail is tenoned between the short legs to take the front of the seat, and at the back another splayed off as at E (Fig. 69) is tenoned in place $\frac{1}{2}$ in. below the front one. At the ends, short rails are fixed connecting the two, and consequently sloping downwards slightly towards the back. Mortised for the front, leg and tenoned into the back, the arm is square except for a cut outline to the front as in Fig. 69, and is intended to be fixed horizontally, not parallel to the sloping

seat, to take which latter four transverse bearers are fixed from front to back, their ends being dotted under the seat in Fig. 64.

The seat itself can be $\frac{3}{4}$ in. thick, composed of two or three pieces cross-tongued together, and having projecting seat, which can then shift slightly without risk of splitting.

The framing of the back is of a lighter character than the rest of the work, and will be observed to slope back as much as possible within the limits of the $2\frac{3}{4}$-in. end posts. It is all $1\frac{1}{4}$ in. thick, and com-

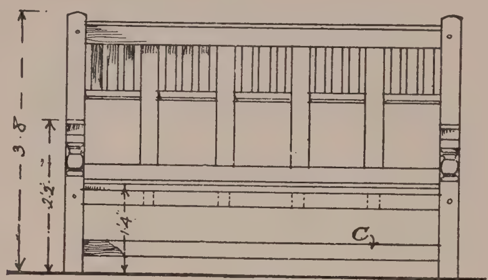


Fig. 64.

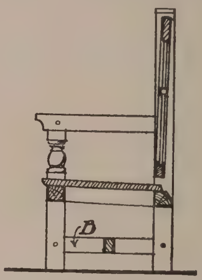
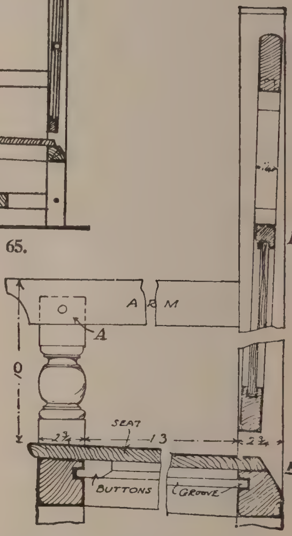


Fig. 65.

Figs. 64 and 65.—Front Elevation and Section through Centre of Garden Seat



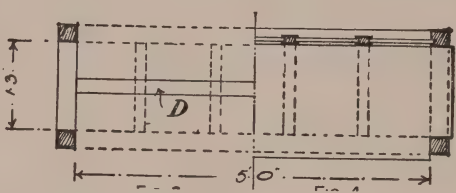


Fig. 66.—Half Plan below Seat

Fig. 67.—Half Plan at Seat Level

Fig. 69.—Enlarged Section of Back and Detail of Seat and Arm

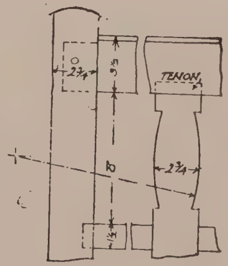


Fig. 68.—Enlarged Detail of Part of Back, showing Optional Shaping of Uprights

Scale of Inches for Figs. 68 and 69

Scale for Figs. 64 to 66

rounded edges except at the back, which can be splayed, as at E in Fig. 69. The seat should not be fixed direct to any of the supports; but the outside bearers should be grooved and arranged with loose wood "buttons," as in Fig. 69, fixed 6 in. or so apart and screwed to the

prises a $3\frac{1}{2}$-in. top rail with rounded upper edges, $2\frac{3}{4}$-in. bottom rail to be fixed about $1\frac{1}{2}$ in. above the seat, and four intermediates $2\frac{3}{4}$ in. wide, their tops either plain or cut to the simple outline indicated, the curve of which is part of a circle of $11\frac{1}{4}$-in. radius (Fig. 68). These parts will

all be tenoned together and to the end posts and filled in with five oak panels fitting in grooves previously prepared, and finished on top with strips of grooved moulding $1\frac{1}{2}$ in. high as at F (Fig. 69), the front being very flatly moulded, because any pronounced projection would be annoying to those leaning against it. Between the rail just mentioned and the top is a space of 8 in., which is intended to be filled in with thin strips $1\frac{1}{2}$ in. or more in width, leaving open spaces between.

It will be well to take the actual sharp arris off all exposed angles of the work, and no glue should be used for joinery required to stand in the open, white-lead being more suitable, if something additional to the pegged joints already mentioned is desired.

TWO RUSTIC SEATS

Much of the commercial "rustic" garden furniture is open to adverse criticism concerning its design and general suitability. The first is frequently extremely poor, and, being devoid of originality, has tended to bring this class of work into a considerable amount of disfavour. At the same time, however, rustic construction is supposed to harmonise with garden surroundings better than other classes of work, and it certainly has the advantages of being easily prepared from material which is often already on hand, or, at all events, material easily obtainable.

A design less liable to reproach on these scores than some is shown by Fig. 70, and consists principally of perfectly straight poles (which may be of larch or some similar variety) arranged in a much simpler manner than is usually encountered. In this design the main uprights are continued upwards, in order to receive an awning or other shelter when desired ; or they could, of course, be kept down sufficiently to leave the arms and back of ordinary heights. For a shady position where provision for an awning is superfluous, Fig. 71 may prove of interest, showing as it does a sketch for a very similar seat with the addition of curved arms and back.

For either seat the construction would be much the same, and, as is usually the case with such work, it need only be of the simplest, not to say crudest, description. The main framework should be of comparatively heavy stuff selected for its straightness, and when cut to sizes suiting the dimensions shown in Figs. 72, 73, and 74, should be carefully fitted so that one piece butts closely against the curved contour of another, and the whole then spiked or screwed very securely together. The minor filling-in pieces can next be readily settled, and they should be fitted in position in such a way as to brace and stiffen the larger parts throughout. As a whole, the construction does not call for an explanation in detail ; but a proposal for the arrangement of the seat is explained by Fig. 75, which is a section of the front bearer of the seat showing it as one-half of a stout circular pole having a fillet spiked on it at the back in order to receive small wrought slats, as at A in Fig. 74, which, of course, rest on a similar bearer and fillet along the back of the seat. These wrought fillets will be found much more satisfactory than any rustic pieces in such a position, and they should slope down a little to the rear, and be rounded off on top to avoid any sharp angles.

As regards the seat shown in Fig. 71, the only special remark is that the top rail of the back to it should be selected curved naturally to a suitable outline, and in both instances it is strongly advised to keep the seat low and wide, and also if practicable to slightly slope both the actual seat and the upright back.

HIGH-BACKED GARDEN SEAT WITH SCREEN

Given for a background a well-matured garden, the model shown in the sketch (Fig. 76) should prove very effective, and repay the labour involved in its construction. It would probably appear to the best advantage if placed at the end of a long central path, and it will be all the better for a raised platform of concrete

finished with pebbles and having a brick edging, which might be curved out in a sweeping line as shown by the plan, while if, say, three wide steps up could be arranged to follow this line, the result would be correspondingly enhanced. Figs. 77, 78, and 79 are part elevation, section through centre and plan respectively.

The design will readily be seen to consist of an angle seat with high back, over which a light sort of screen or arbour is erected. This latter is standing 7 ft. 3 in., composed of two posts above the platform or ground level, at least 3 in. square and tapered slightly, if possible, towards their tops, which are tenoned into a light horizontal head with shaped ends projecting 9 in. beyond the posts. Under this is fixed an upright 1-in. board, having its lower edge shaped to a flat hollow curve as shown. This completes the front part, which should be erected with the posts securely bedded in the ground, preferably with concrete round their ends. The back supports can next be attended to. They stand 3 ft. 3 in. to the rear, and constitute practically a reduced copy of the front, two smaller posts standing 6 ft.

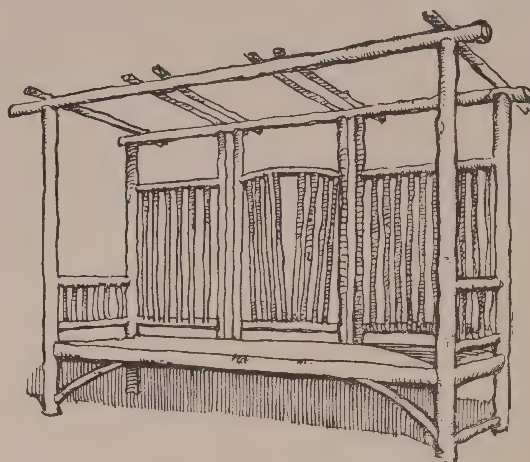


Fig. 70.—Rustic Seat with Framed Top

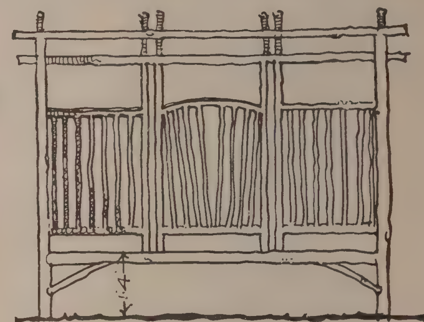


Fig. 72.

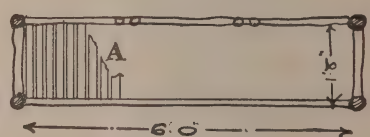


Fig. 74.

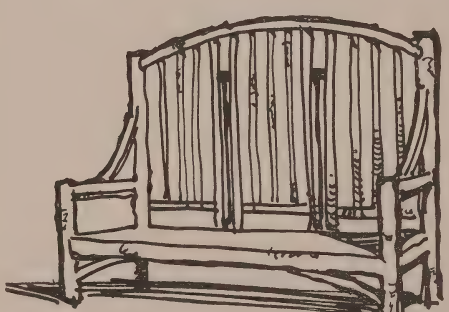


Fig. 71.—Alternative Design of Rustic Seat

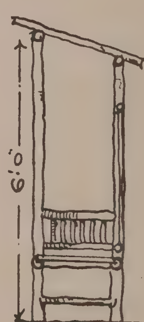


Fig. 73.

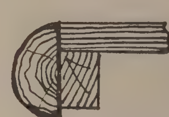


Fig. 75.—Detail of Seat Support

Figs. 72, 73 and 74.—Front and End Elevations and Plan of Seat

high and 5 ft. 6 in. apart, supporting a head with shaped ends, the upper surface of which (as also that of the one first described) is taken off to the required angle to suit a number of laths arranged on the slope in a radiating fashion, to take climbing roses or creepers. The back is filled in with trellis, which might be made up in a square form, rather than to use the common diagonal pattern, and the sides could be enclosed in a similar way if desired.

The seat is independent of the surrounding work, and will be found rather more difficult to construct, the reader being particularly referred to the enlarged details shown. Incidentally it may perhaps be as well to mention that the angles for the setting out on the plan are all drawn with the ordinary 60° set-square, also that the front edge of the central part of the seat is 3 ft. long, while the sides are each 2 ft. 3 in. clear in front.

Taking first the half plan (Fig. 79) to the left of the centre line, this shows the four main uprights of this half of the framing (A, B, C, and D), the two back ones being 4 ft. 9 in. high with rounded tops, and the exact heights of the others being shown on the details. The first three are each 2 in. by 2 in. square, while D should be 3 in. by 2 in., or at least $2\frac{1}{2}$ in. by 2 in., in order to properly take the other parts which will have to be jointed into it; B and C are connected up to form the end framing by the arm E and bottom rail F shown on the detail (Fig. 80), while between them at the distance figured above the ground is a bearer G (reduced from 3 in. by 2 in. in front to 2 in. by 2 in. at

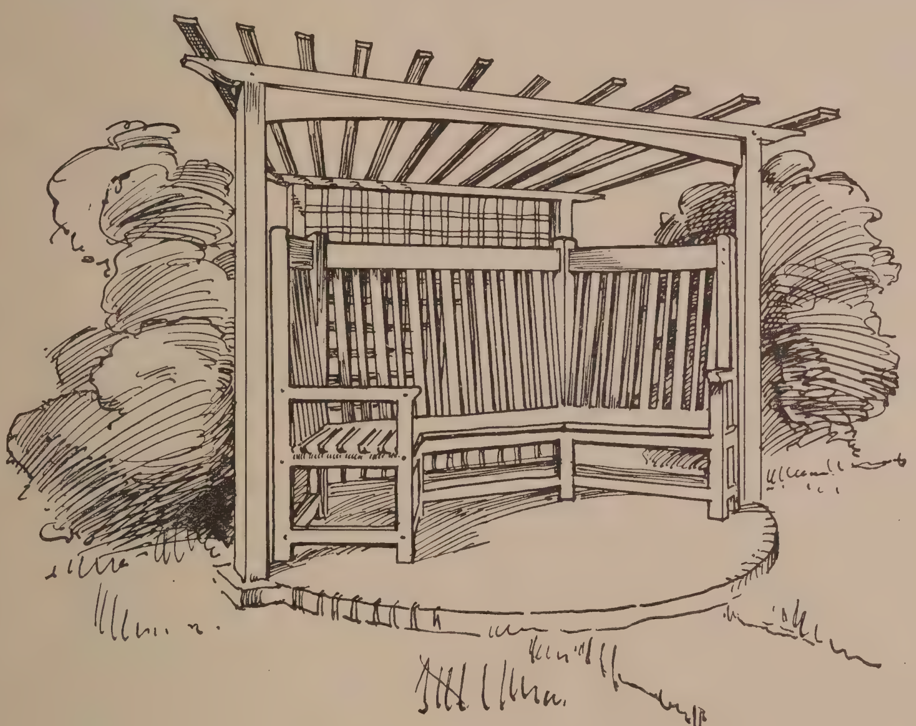


Fig. 76.—High-backed Garden Seat with Screen

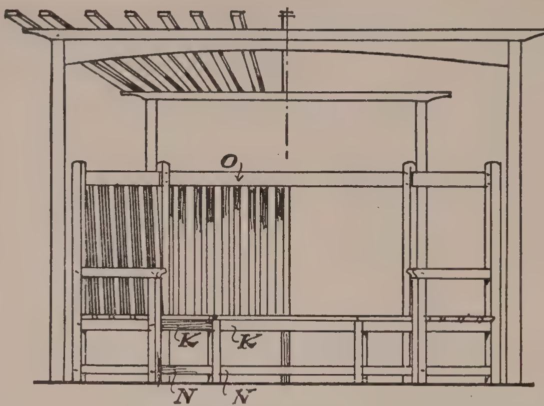


Fig. 77.

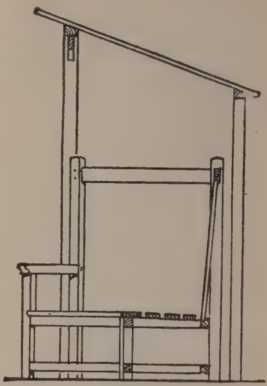


Fig. 78.

Figs. 77 and 78.—Part Elevation and Section through Centre of High-backed Garden Seat

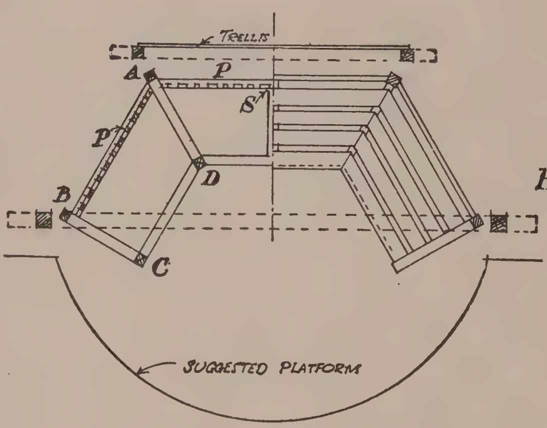


Fig. 79.—Plan of Seat

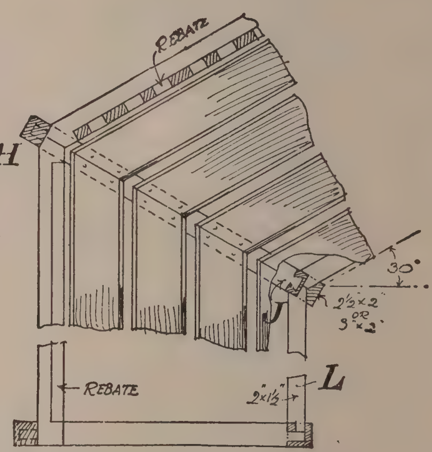


Fig. 81.—Detail Plan of One Angle

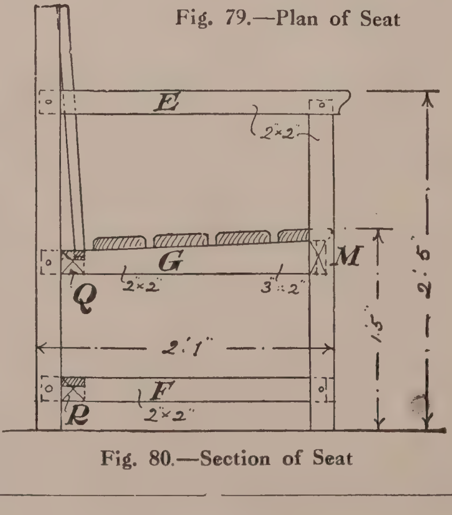
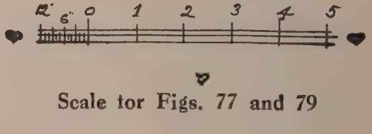


Fig. 80.—Section of Seat



Scale for Figs. 77 and 79

Scale for Figs. 80 and 81

the back end), which is framed into B and C. All these six joints are simple tenons, and it is suggested that they be secured with oak pegs driven through the centres.

Uprights A and D are connected in a somewhat similar manner, omitting the arm rail; but being on the skew, as compared with the end framing, their distance apart will be a little greater, and must be decided by exact setting out of the work. A detail plan of this part is given (Fig. 81), which shows at H the bearer tenoned into the back upright and dovetailed into the front one at J. This joint will make the best job, although a tenon could be substituted. These two parts of the framing are then joined to each other and to the corresponding parts of the other half of the seat by means of the following: (*a*) 2-in. by 1½-in. rails under the front edges of the seat, as K K on front view, and L on the detail plan, which shows an ordinary tenon at one end and a special form at the other (J), to suit this particular case. The object is to cut away as little as possible of the upright, consistently with producing secure work. These rails are only 1½ in. wide to allow ½ in. for a rounded edge to the front board of the seat, without this projecting beyond the line of the uprights (*see* M on detail of end).

(*b*) 2-in. by 2-in. bottom rails (N) tenoned in a similar manner at each end.

(*c*) 4½-in. by 1¼-in. heads (as O, front view) housed into the back uprights.

(*d*) 2-in. by 2-in. back bearers (as P on the plan and Q on the detail of the end). These are fixed in position as indicated at Q, by halving with the seat bearers G, and they have a rebate ¾ in. wide to take the laths forming the filling in to the back, which also fit into a rebate worked along the front lower edge of the top piece O. These laths are alternately 1¼ in. and 2 in. wide or thereabouts, with 2-in. spaces between, and only require careful fitting and nailing into the rebates just described.

(*e*) The last connection between the framings at A and B will be a 2-in. by 2-in. rail, similar to Q, and halved in the same way over the bottom rails as at R on the detail of the end.

When the seat has been formed with 4½-in. by 1-in. boards with rounded angles, nailed in position at equal distances, and mitred as shown on the detail plan, the work will have been completely specified, with the possible exception of a short upright, which it may be found advisable to introduce to stiffen the back bearer in the centre, at S on plan.

Paint or some preserving stain may be adopted as a finish, and it will be as well to keep always in mind the need of solidity for work of this character, which has to stand forsaken through long periods of rain that severely test the quality of both material and workmanship.

ORNAMENTAL SEAT FOR GARDEN

The garden seat shown by the photograph (Fig. 82) is of a convenient yet uncommon design, and the utilisation of the ends as seats economises space. The seat is shown painted and enamelled white. The working drawings Figs. 83, 84 and 85 are to the scale shown on page 527.

The material required is as follows: 3-in. by 3-in. legs—eight 3 ft. 6 in. and four 2 ft. 6 in.; 6-in. by 2-in. rails—two 2 ft. 8 in. and four 5 ft. 6 in.; 4-in. by 2-in. rails—two 4 ft., four 1 ft., and four 10 in.; 3½-in. by 2-in. rails—four 1 ft. and two 4 ft.; 2-in. by 2½-in. arms—four 1 ft.; 2½-in. by 1-in. laths to seats and back—ten 5 ft. 6 in., ten 4 ft., and forty-six 1 ft. 6 in.; 3-in. by 1-in. front laths—two 5 ft. 6 in. and two 4 ft.; 6-in. by 1-in. panels—four 9 in.; 5-in. by 1-in. feet—four 5 in. and four 1 ft. 1 in.; 3-in. capping—two 2 ft. 6 in., one 2 ft. 2 in., two 1 ft. 8 in., and eight 1 ft.; 3-in. by 2-in. cross rails under the seats—six 1 ft. 5 in.; 1-in. by ½-in. false ends—four 8 in. and four 10 in.; 3-in. by 2-in. muntins in the seat backs—two 1 ft. 9 in.; 2-in. by 2-in. muntins in the seat backs—two 1 ft. 9 in.; 1½-in. by 1-in. bearers for seat-lath ends—eight 1 ft. 3 in.

Fig. 83 is a sectional end elevation; Fig. 84 a front elevation, and Fig. 85 a plan of one half and a cross horizontal section of the other half, omitting the

laths to show the arrangement of the rails under. Figs. 86 and 87 give enlarged details of two joints used in the construction of the seat. Most of the joints are based on the ordinary mortise-and-tenon joint. The cross rails supporting the seat laths and binding the seat together are fixed with a stop dovetail joint (*see* Fig. 86). The corner rails are fixed with a mortise-and-tenon joint as in Fig. 87, being necessarily arranged differently to the mortise-and-tenon joint that is cut in the direction of the grain. The back framing is crowned with a capping, as shown in section by Fig. 88. The panels in the end seats under the arms are fixed in grooves cut in the arm (underside) and the rail at the bottom. The front legs of the end seats are tapered to 2 in. square at the top end.

The legs of wooden seats of this description are subject to wet rot, due to standing with their exposed ends in the ground, and thereby absorbing moisture, with no opportunity of drying by ventilation. This is guarded against by fixing 1-in. pieces, chamfered on the edge, to the ends of the legs, thereby not only saving

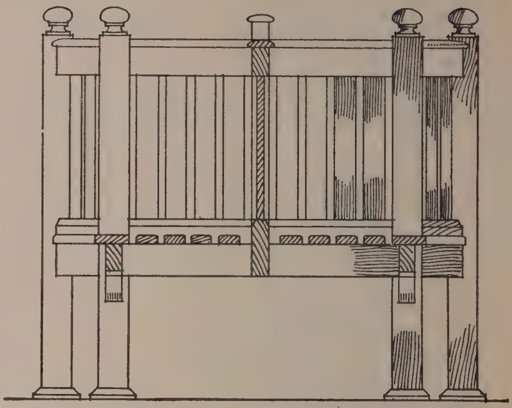


Fig. 83.—Sectional End Elevation of Seat

the ends of the legs, but at the same time introducing a neat and ornamental feature to the general appearance of the seat. The panelling on the back framework is of $2\frac{1}{4}$-in. by 1-in. laths, fixed $\frac{1}{2}$ in. or so apart.

In arranging the woodwork of outdoor work, account should be taken of the fact that when wood is joined in any way, decay begins there first ; therefore as few

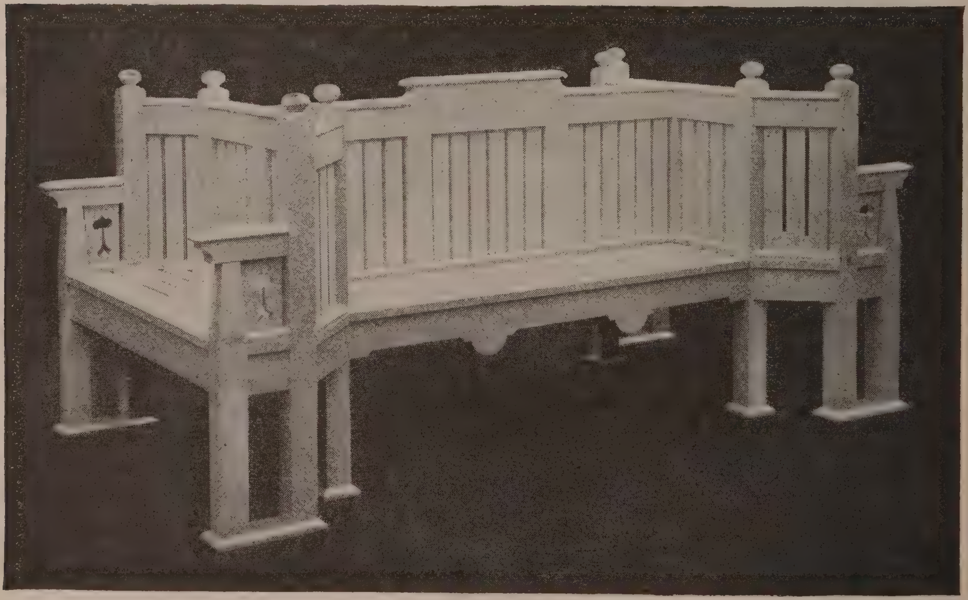


Fig. 82.—Ornamental Garden Seat

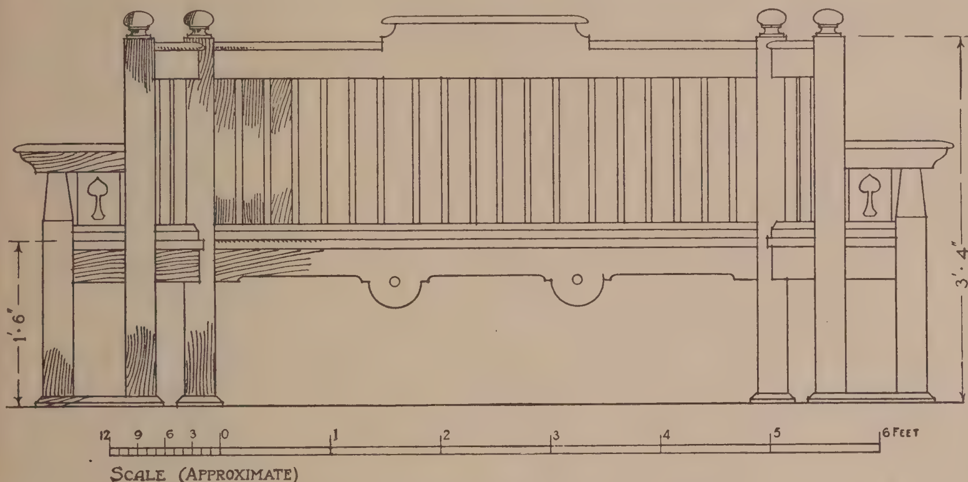


Fig. 84.—Front Elevation of Garden Seat

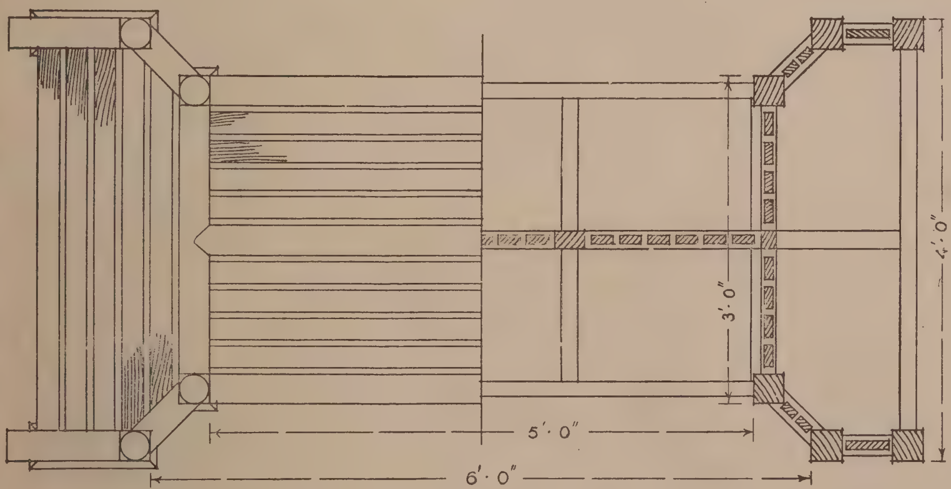


Fig. 85.—Half Plan and Half Horizontal Section of Garden Seat

joints as possible shou'd be used. If it is possible to get the wood exposed on all its sides, so much the better. This is so in the present case. The laths forming the back panelling touch wood only at each end, and as all joints made are painted together with white-lead, and the whole seat is given four coats of paint and one of white enamel, the chances of decay due to exposure are reduced to the lowest possible minimum. The only nails used are in fixing the seat laths, and they should be punched in and well puttied with oil putty after the first or priming coat. The mortise-and-tenon joints, which in most cases cannot be wedged (except by a hidden or fox wedge), are pinned with wooden pins. The top rail, which is

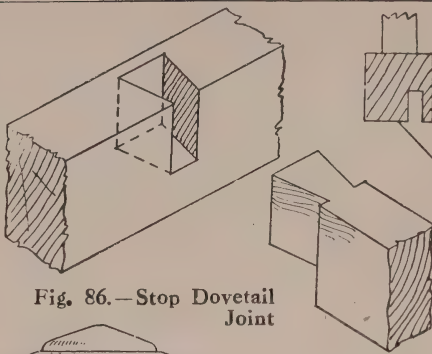


Fig. 86.—Stop Dovetail Joint

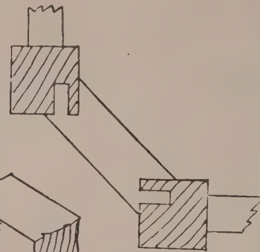


Fig. 87.—Joint of Corner Rails

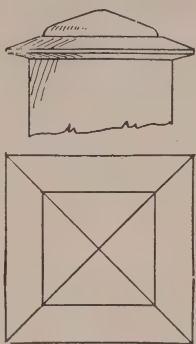


Fig. 89.—Elevation and Plan of Alternative Capping

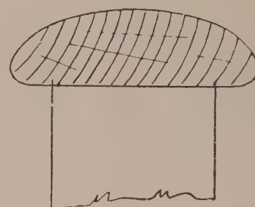


Fig. 88.—Section of Capping

raised in the centre, is made all in one piece. It could, for the sake of economising timber, be made in two pieces, the top and shorter piece being screwed down to the longer rail; but the objection to this is that a joint is thereby formed, which if water once gets in causes decay.

For this reason the exposed top ends of the legs are a source of weakness, although the turning of the ends reduces this, because of the pressure of the turning tool compressing and hardening the end.

The turning should be as fat and solid as can be obtained; no project-

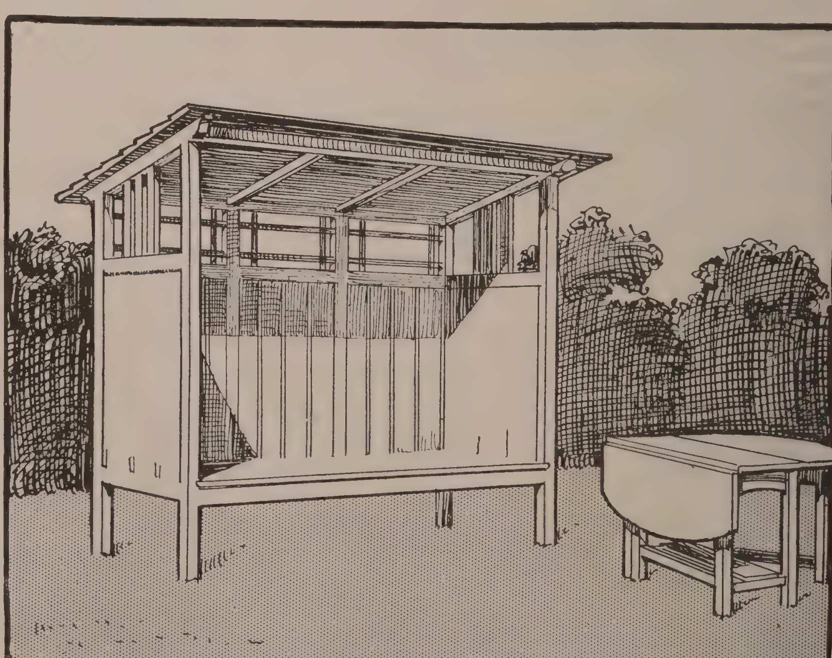


Fig. 90.—Hooded Garden Seat and Table

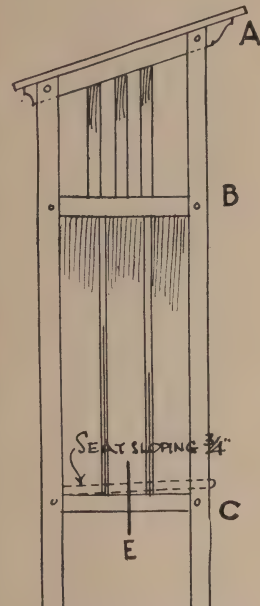


Fig. 91.

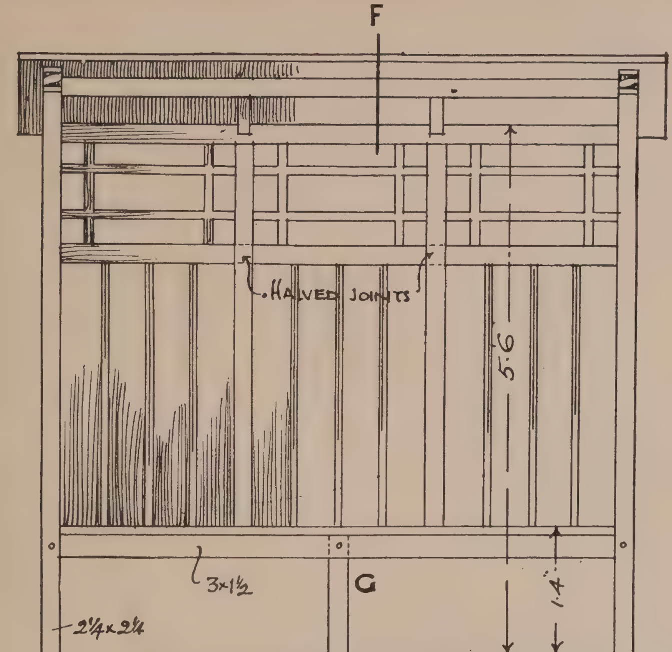


Fig. 92.

Figs. 91, 92 and 93.—End Elevation, Front Elevation and Plan (Part of Seat removed) of Hooded Seat

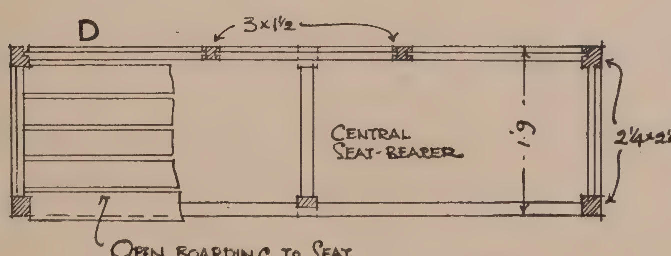


Fig. 93.

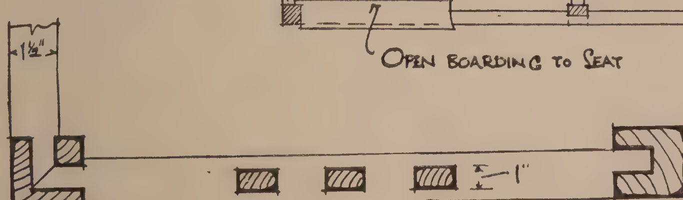


Fig. 94.—Detail Plan at B (Fig. 91)

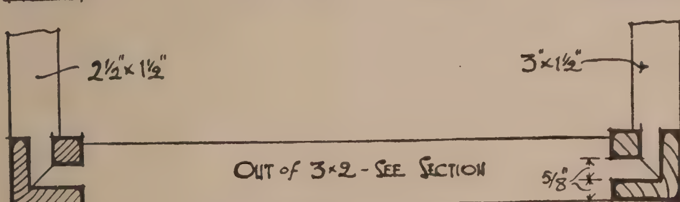


Fig. 95.—Detail Plan at C (Fig. 91)

Scale for Figs. 91–93 and 98

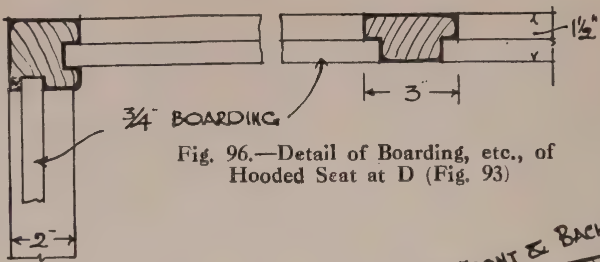


Fig. 96.—Detail of Boarding, etc., of Hooded Seat at D (Fig. 93)

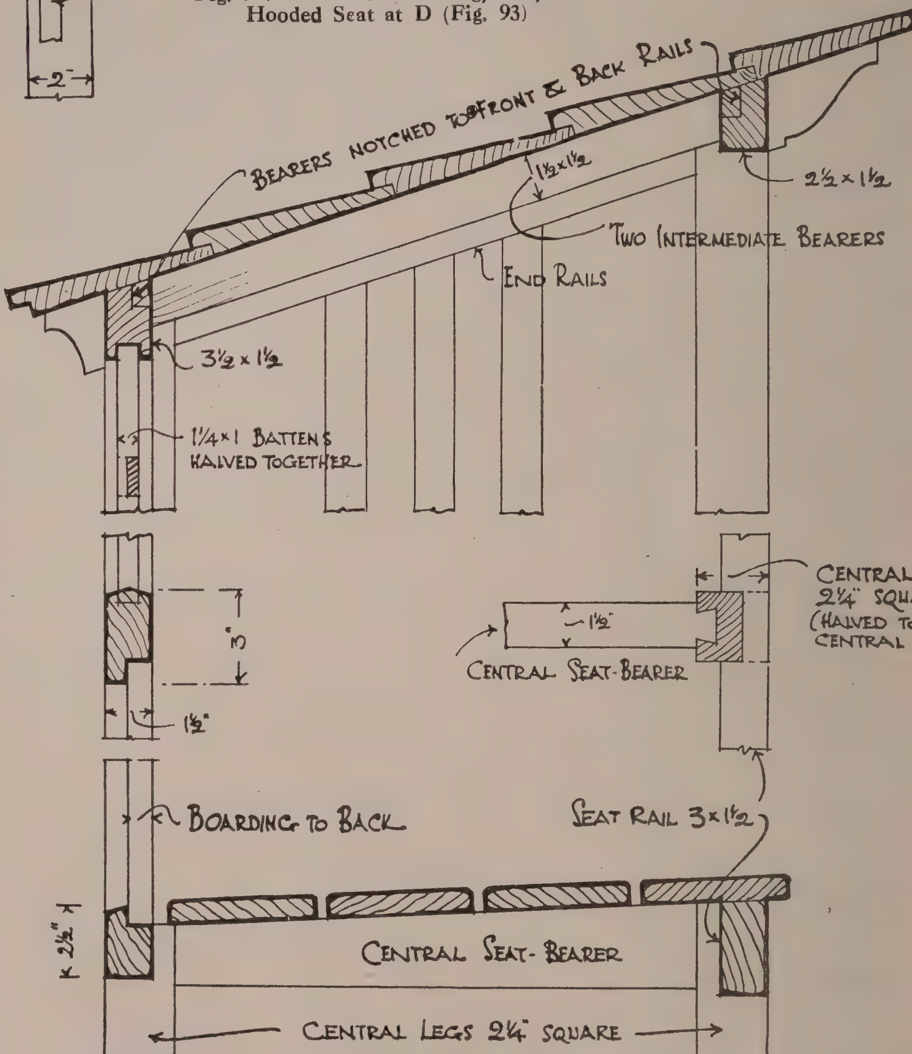


Fig. 97.—Detail Section at F, Horizontal Section at G, and Detail Section of Seat (Fig. 92)

Scale for Figs. 94–97 and 99–105

ing members that would easily be broken off by the weather should be introduced. An alternative method is to cap the ends, as shown in Fig. 89. In putting the seat together, it is a good plan to paint all the separate parts first—tenons, dovetails, and mortises; the mortises should be especially well painted. Then next day put the seat together, again using paint for the joints. In this way the joints are protected from decay as far as is possible. If a double seat is too large, a single-fronted seat can be made by omitting one side and drawing up the ends.

HOODED SEAT AND TABLE

The hooded seat and table shown in Fig. 90 (p. 528) are of simple construction and are for garden or outdoor use. The end elevation, front elevation and plan of the seat are shown in Figs. 91, 92, and 93; various details are given in Figs. 94 to 105.

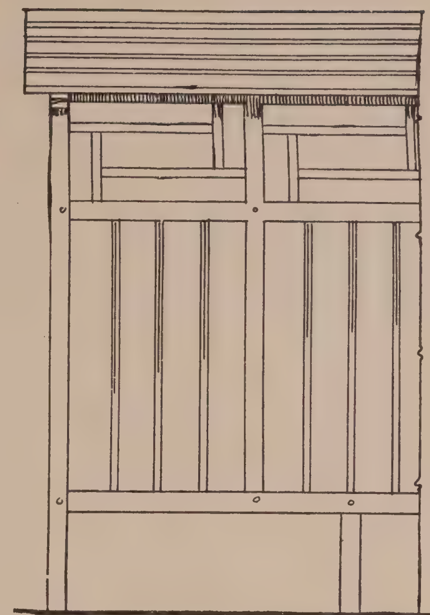


Fig. 98.—Part Back Elevation of Hooded Seat with Alternative Arrangement of Bars at Top

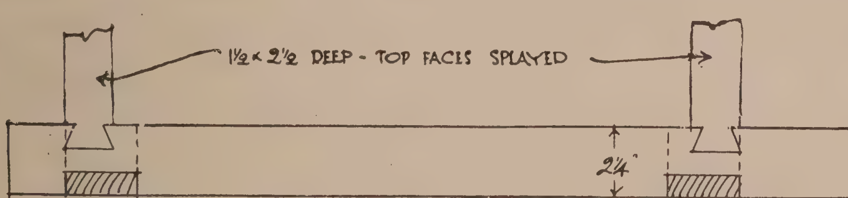


Fig. 99.—Detail Plan of Hood of Seat at A (Fig. 91)

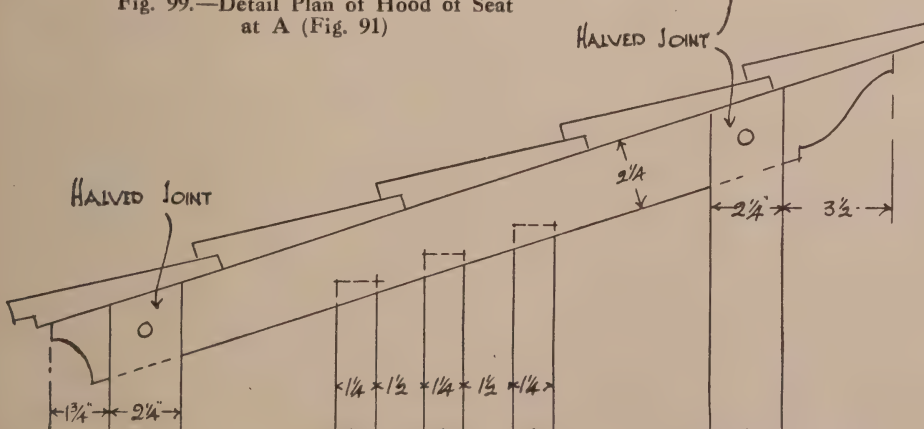


Fig. 100.—Detail Elevation of Hood of Seat at A (Fig. 91)

The seat is composed of four boards with open joints supported by the two end rails and a centre bearer. Note that owing to the slope of the seat the rails and bearer are tapered in width (Figs. 94 and 95). The back and sides are boarded at the bottom and filled in with open bars at the top. An alternative arrangement of the bars is shown in Fig. 98. Two pieces $\frac{1}{2}$ in. by $1\frac{1}{2}$ in. in section are dove-

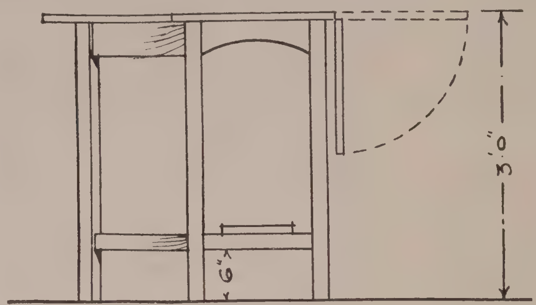


Fig. 102.

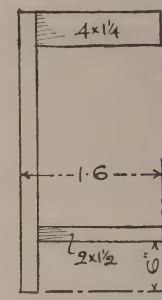


Fig. 103.

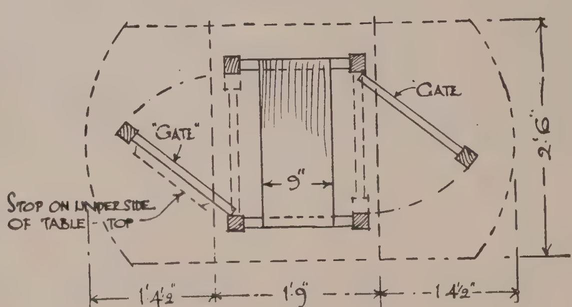


Fig. 104.

Figs. 102, 103 and 104.—Side Elevation (one flap down), Side Elevation of Gate and Detail Plan of Table, showing Top Rails of Central Post and Position of Gate when closed

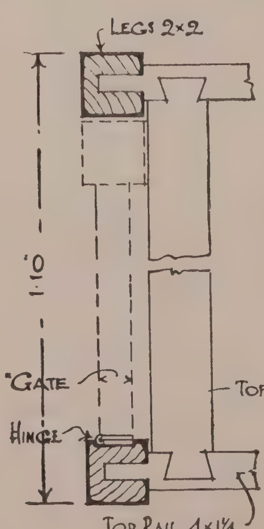


Fig. 105.—Detail Plan of Table showing Top Rails of Central Part and Position of Gate when closed

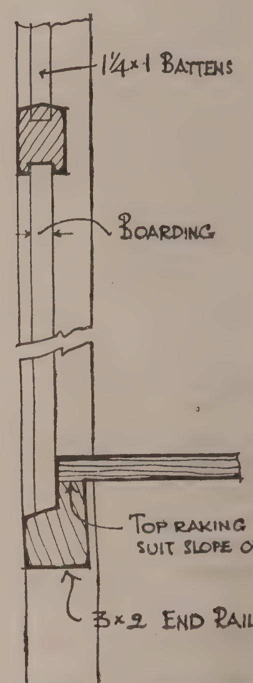


Fig. 101.—Detail Section of Corner of Hooded Seat at E (Fig. 91)

tailed (Fig. 99), between the top rails to give rigidity to the roof, and to afford adequate bearing for the rebated and weathered roof boarding. Details of the construction of the sides are given in Figs. 99 and 100. A detail of a back corner showing the boarding is shown in Fig. 102.

Hinged Table.—The table (Figs. 102 to 105) consists essentially of a rectangular fixed portion having four legs; between the legs on each of the long sides of the table a "gate," or auxiliary leg, is hinged. Each of these folding legs supports a flat (or extending) leaf hinged to the centre table top. The "gates" are hinged so that when they are closed they allow the hinged flaps to drop.

GARDEN CHAIR-SWING

The two swinging chairs are supported in a large trestle-like frame, as shown in Fig. 106. This method of spreading the posts outwards gives the framework a firmer foundation, and counteracts any tendency of the swing to overturn. If the four posts are allowed to enter the ground about 6 in., the swing frame can be made a temporary fixture, and should any alteration of position be desired, no great difficulty will be experienced in removing it.

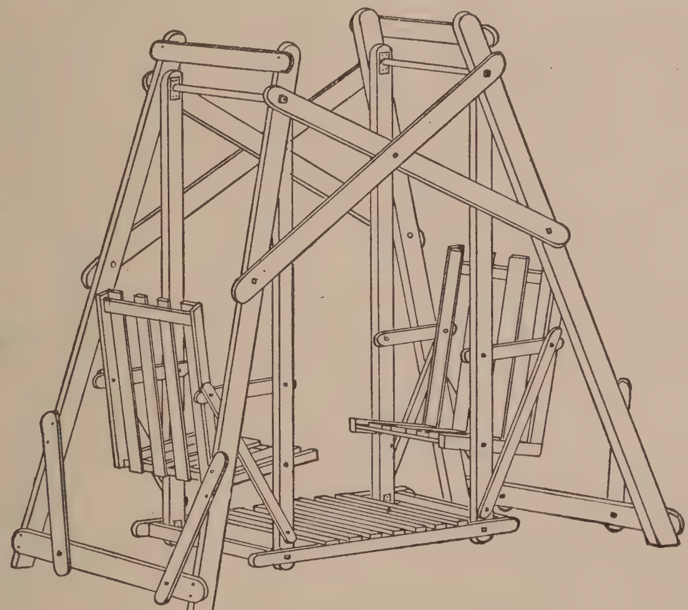


Fig. 106.—Garden Chair-swing

The whole is made of good quality deal scantlings, and should be constructed as follows: Figs. 107 and 108 are the side and front elevations of the swing, and show the lengths of all the pieces before the chairs are fixed in position. All the pieces should be prepared by planing to the sizes given. The $\frac{3}{8}$-in. bolt holes are bored with a pin bit, and bored so that the bolt has a free fit so as not to split the wood when it is driven in. The ends are cut off with a bow-saw a sufficient distance away from the bolt holes, so that it is not likely to split when the strain is on the framing. The ends are then finished off with a spokeshave. The holes at A are bored large enough to receive two long

bolts having a thread at each end to receive the nuts. As these bolts take the weight of the swing, it is necessary to have them made of $\frac{5}{8}$-in. round iron.

The cross braces strengthen the side frames, and these frames are held together by pieces at the top and bottom. These are screwed on the edges of the long posts each side, as shown at B and C in Fig. 108. The struts in the lower corners are bolted on to the lower cross bearers and screwed on the edges of the posts. These are necessary to prevent the frame distorting sidewise. Fig. 109 shows the platform on which the chairs are fixed. It consists of two side pieces into which are mortised

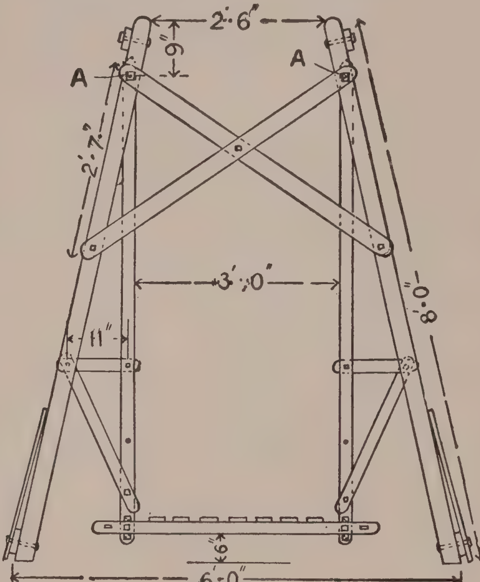


Fig. 107.

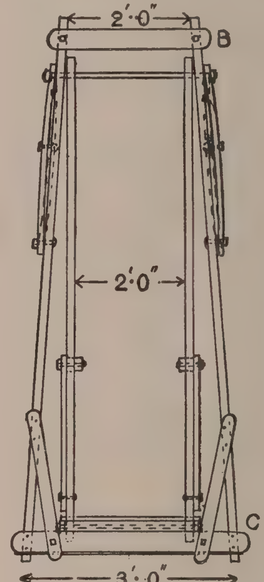


Fig. 108.

Figs. 107 and 108.—Side and Front Elevations of Chair-swing

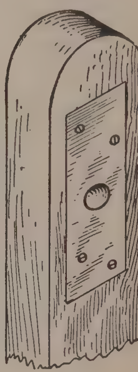


Fig. 110.—End of Support with Cheek-plate

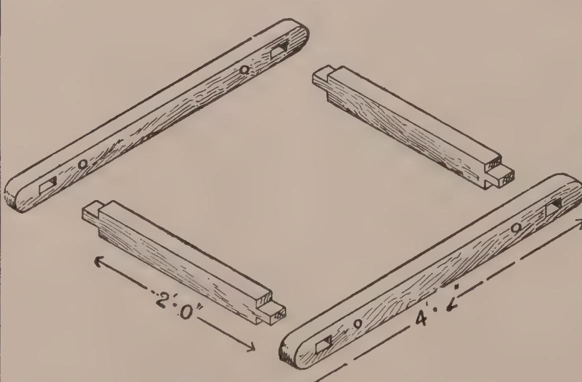


Fig. 109.—Platform Framing of Chair-swing

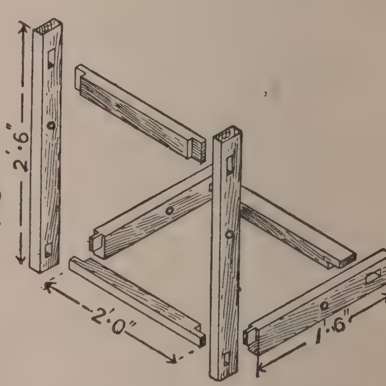


Fig. 111.—Framing of Chair

and tenoned two cross pieces ; these joints are held securely together by pinning. About 2 in. away from the cross pieces holes are bored in the side pieces to receive the long bolts, the same as those at the top. Strips or battens are then screwed on to the top of the side pieces. To ensure the full working of the upright supports, these strips should not be fixed too close to the same. The holes in the supports should be bored about $2\frac{1}{2}$ in. or 3 in. from each end, so as to fit freely on the long bolts. Sixteen small cheek-plates will be required for the four supports. These are made of $\frac{1}{8}$-in. hoop iron, 4 in. long and $1\frac{1}{2}$ in. wide, as shown in Fig. 110. The holes should be drilled large enough to fit freely on the long bolts. Fig. 110 shows an end of a support with a cheek-plate screwed on.

The chairs are bolted on to the upright supports by triangular framing. The arms of the chairs are fixed to the supports in front, and the back ends are supported by a strut which takes its thrust from a bolted joint lower down the support. The back and seat of the chair are bolted on to this triangular framing, as shown in Fig. 110. Two pieces are carried across the back of the chair and one across the seat of the chair. On these are nailed the laths to form the back and the seat. All the chair bolts are $\frac{5}{16}$ in. in diameter, and should be washered before they are screwed up. Fig. 111 shows the mortise-and-tenon joints before they are driven together and pinned.

All the pieces should be painted before they are bolted together. The sizes of all the pieces required are : Slanting posts, $2\frac{1}{2}$ in. by $\frac{7}{8}$ in. ; cross braces, $2\frac{1}{2}$ in. by $\frac{7}{8}$ in. ; corner struts, 2 in. by $1\frac{1}{4}$ in. ; top and bottom cross bearers, $2\frac{1}{2}$ in. by $\frac{7}{8}$ in. ; platform framing, $1\frac{3}{4}$ in. by $1\frac{1}{4}$ in. platform strips, $1\frac{1}{2}$ in. by $\frac{3}{4}$ in. ; upright supports, $1\frac{3}{4}$ in. by $1\frac{1}{4}$ in. ; chair framing, $1\frac{1}{2}$ in. by $\frac{7}{8}$ in. ; and chair laths, $1\frac{1}{4}$ in. by $\frac{1}{2}$ in.

ERECTING A GARDEN SWING

The general idea of a simple swing is given in Fig. 112, and also shows the construction below the ground which is necessary to keep the posts from shaking loose by the action of swinging. Figs. 113 and 114 give front and end elevations of the swing. The timbers with which the swing is to be made may be of oak, ash, or pitch-pine ; but if these are not available and a cheaper material is desired, good red deal might be used.

The dimensions of the swing are 8 ft. 11 in. high from the ground, and 5 ft. between the posts, the ends of which, with the sill, are sunk 3 ft. 6 in. in the ground. It will be as well to first give a list of the timbers, as from this it may

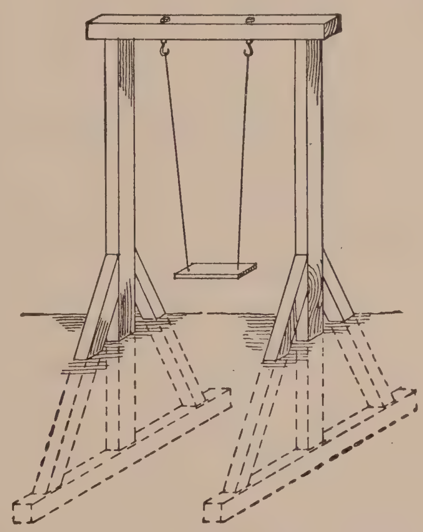


Fig. 112.—Garden Swing showing Construction Below Ground

be seen at a glance all the pieces that will be required, and so facilitate matters in the cutting up and in the ordering of the stuff. Two pieces 11 ft. 10 in. by 1 in. by 4 in. for the posts ; one piece 6 ft. 8 in. by 7 in. by $5\frac{1}{2}$ in. for the head ; two sills 6 ft. 6 in. by 6 in. by 6 in. ; and four struts 6 ft. by 4 in. by 4 in.

To begin, first take the two posts, and at both ends of each cut a stub tenon 4 in. by 3 in., which should fit tightly and squarely into the mortise in the headpiece and sill. The posts are further secured to the head with $2\frac{1}{2}$-in. by $\frac{1}{4}$-in. iron straps, hammered to shape and fastened with screws ; but this fixing is best left until

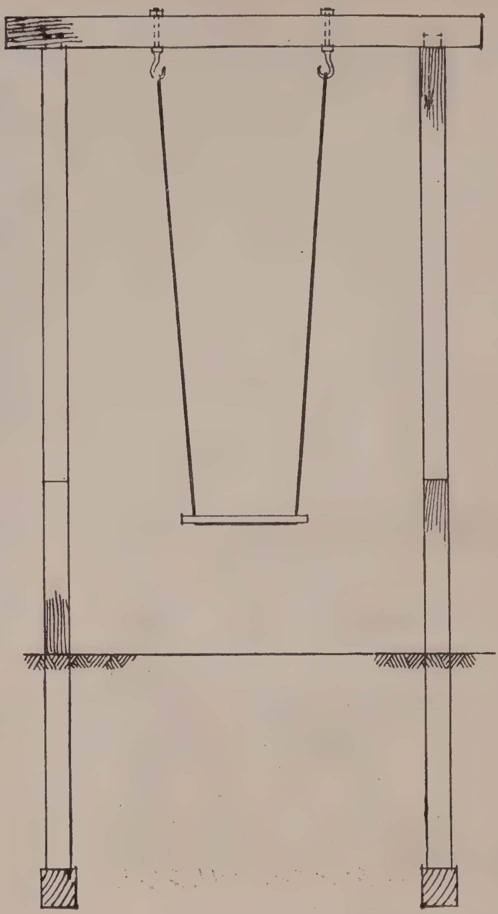


Fig. 113.

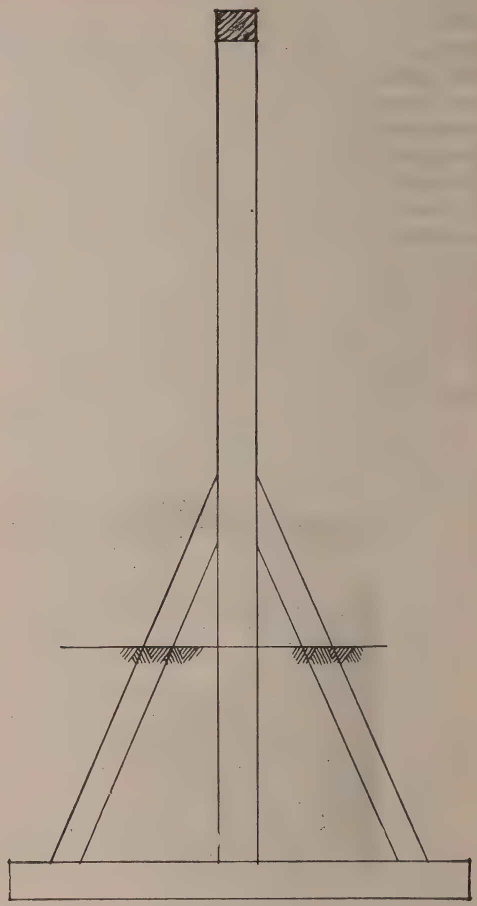


Fig. 114.

Figs. 113 and 114.—Front and Side Elevation of Garden Swing

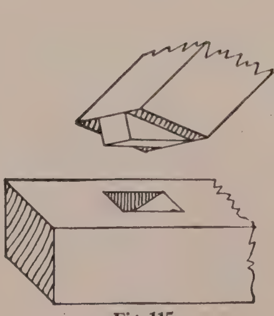


Fig. 115.

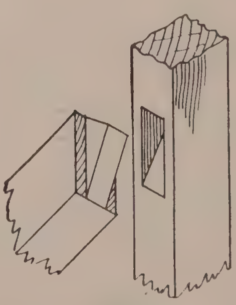


Fig. 116.

Figs. 115 and 116.—Joints of Diagonal Strut

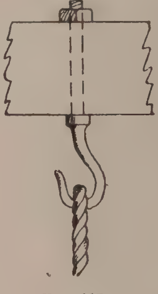


Fig. 117.

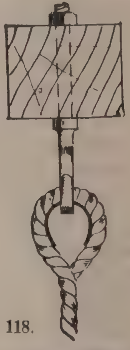


Fig. 118.

Figs 117 and 118.—Side and Front Elevations of Suspension Hook

all is ready for erection. The diagonal struts are jointed to the posts and sill in the manner shown by Figs. 115 and 116, and the struts should be additionally strengthened with $\frac{1}{2}$-in. bolts. The suspension hooks are shown enlarged by Figs 117 and 118, and if facilities are not at hand for making them, they may be procured from a local ironmonger. The hooks are fixed in the head 2 ft. 6 in. apart with a nut, and care must be taken to have a good-size iron washer between the nut and the wood. Good stout manilla rope or galvanised-iron strand wire must be used to suspend the seat, and it is important to have galvanised-iron thimbles to work in the hooks. Over these thimbles the rope should be properly spliced. For the seat, cut a piece 2 ft. long and 10 in. wide from a $\frac{3}{4}$-in. board, and after planing, screw a piece of $\frac{1}{2}$-in. stuff 5 in. wide on the underside at each end to strengthen the board. The seat should be suspended so that it is about 1 ft. 9 in. above the ground; all edges and corners should be rounded off.

The posts and struts should now have the corners taken off or chamfered, and the parts of the framework that are to be below the ground must be well tarred or creosoted. The upper portions should be given two or three coats of paint. After making the excavation, the trenches should have a 6-in. broken brick foundation, which must be well rammed and levelled, and the swing is placed in position and the trenches filled with stones and small material.

FOLDING SEE-SAW

A see-saw is much safer than a swing, and while the latter can only be used by one child at a time, two or even more may use a see-saw. The folding see-saw shown by Fig. 119 is not difficult to make, and requires but a small amount of material. It is made with a top frame, which is fitted with a middle and two end seats, the latter being fitted with folding backs. The top is hinged to a folding stand, which may easily be adjusted at three different heights.

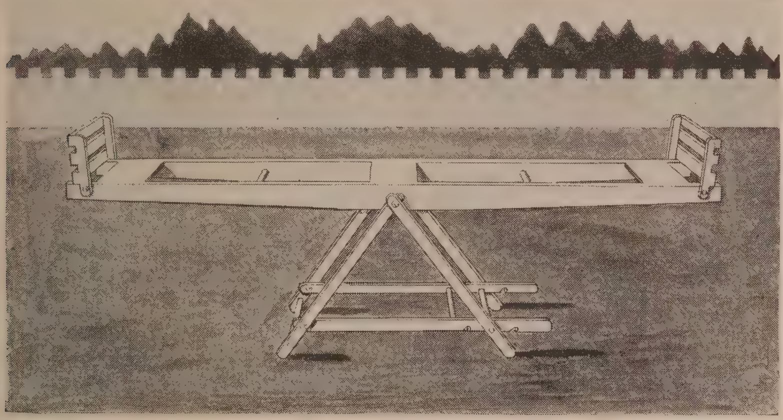


Fig. 119.—Folding See-saw

Fig. 121 shows the see-saw folded. In making, it is essential that a hardwood should be used, say, ash or birch, finished with stain and varnish.

The sides A (Figs. 120 and 122) are 9 ft. long by 4 in. deep in the middle, and $2\frac{1}{2}$ in. deep at the ends by 1 in. thick. The end seats B and the middle seat C are 1 ft. 6 in. long by 8 in. wide by $\frac{3}{4}$ in. thick, dovetailed into the sides, as shown by Fig. 123, and fixed with screws. The two connecting rails D are 1 ft. 6 in. long by 1 in. in diameter, and are framed into the sides,

for which purpose the ends of the rails are cut, as shown in Fig. 124. The folding seat backs are made as shown in Figs. 125 and 126, each having two sides (E, Fig. 120) connected by three battens (F, Fig. 120). The sides are 10 in. long by $1\frac{1}{2}$ in. wide by $\frac{3}{4}$ in. thick, and the battens are 1 ft. $7\frac{3}{4}$ in. long by 2 in. wide by $\frac{3}{4}$ in. thick. The backs are hinged to the sides of the top frame by means of rivets (*see* Fig. 131). Care must be used in boring the holes for the rivets, to see that the backs will fold flat, and when open will stand a little out of the perpendicular. Rivets about $\frac{3}{8}$ in. in diameter should be used. Iron washers $\frac{1}{8}$ in. thick are placed between the frames, and similar washers are placed under the heads of the rivets.

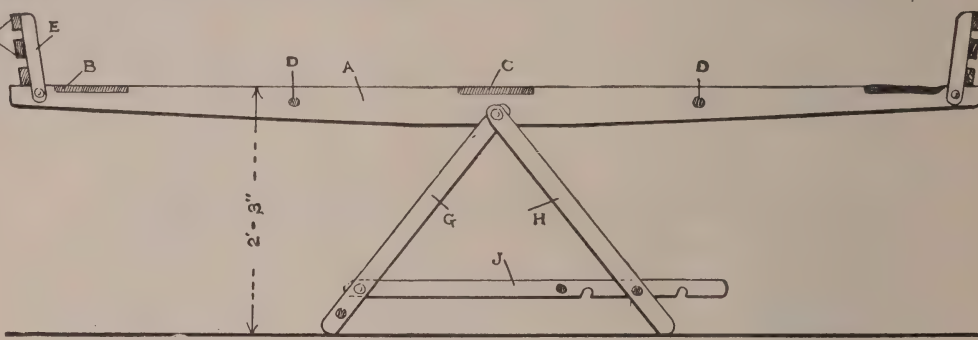


Fig. 120.—Front Elevation of See-saw

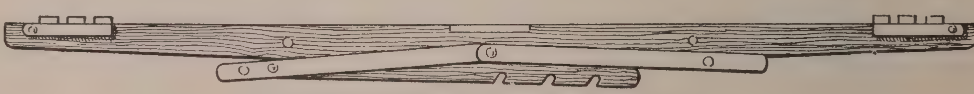


Fig. 121.—Front Elevation of See-saw Folded

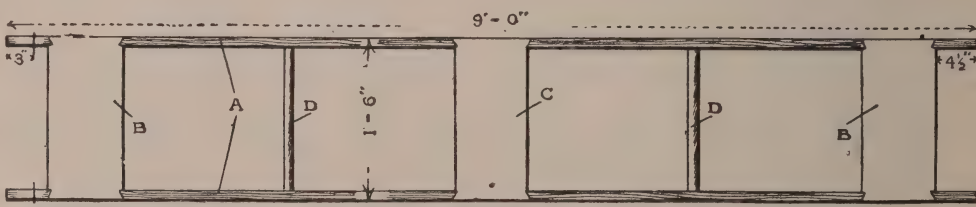


Fig. 122.—Plan of Top Frame of See-saw

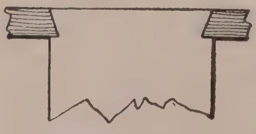


Fig. 123.—Joint for Seats

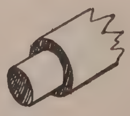


Fig. 124.—Joint for Rails

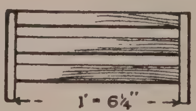


Fig. 125.

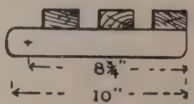


Fig. 126

Figs. 125 and 126.—Details of Seat Backs

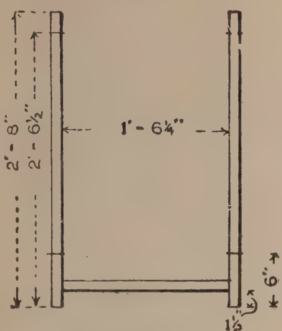


Fig. 127.

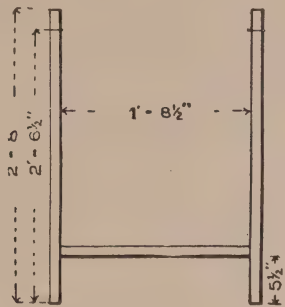


Fig. 128.

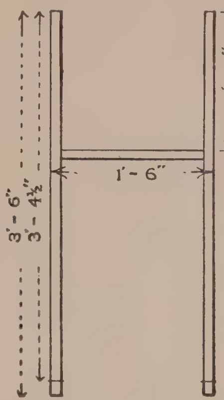


Fig. 129.

Figs. 127, 128 and 129.—Elevations of Frames comprising Stand

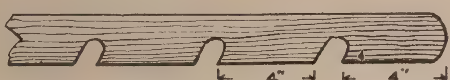


Fig. 130.—Notches in Rails for Adjusting Stand

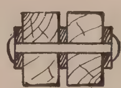


Fig. 131.

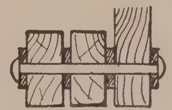


Fig. 132.

Figs. 131 and 132.—Hinged Joints of Frame

The stand is made with three frames G, H, and J. The frame G is shown by Fig. 127, and is made with two side rails, which are 2 ft. 8 in. long by 2 in. wide by 1 in. thick, and a cross rail 1 ft. $8\frac{1}{4}$ in. long by 1 in. in diameter. The cross rail is framed into the side rails with joints, as shown in Fig. 124. The frame H is shown by Fig. 128, and consists of two side rails 2 ft. 8 in. long by 2 in. wide by 1 in. thick, and a cross rail 1 ft. $10\frac{1}{2}$ in. long by 1 in. in diameter. The frame J is shown by Fig. 129, and consists of two side rails 3 ft. 6 in. long by 2 in. wide by 1 in. thick, and a cross rail 1 ft. 6 in. long by 1 in. in diameter. Holes $\frac{3}{8}$ in. in diameter for hinging the frames together are bored in the positions shown in Figs. 127, 128, and 129, and notches 1 in. wide and quite $\frac{3}{4}$ in. deep are cut in the side rails of the frame L, in the positions shown by Fig. 130. The frames G and H are hinged to the sides of the top frame with rivets which pass through all three frames, as shown in Fig. 132, $\frac{1}{8}$-in. washers being placed between each. The frame J is hinged to the frame G with rivets, as shown in Fig. 131. The notches in the side rails of the frame J engage with the cross rail of the frame H when fixing or adjusting the see-saw.

Garden Baskets

GARDENER'S TRUG OR BASKET

THE word "trug" will not probably have any meaning for a great many readers, but when they see the photograph the case will be altered. The above is the name given to what is called a garden basket in a good many parts of the country, although the former name is that used by the makers themselves. But as these are localised in a small village in Sussex the name has not gained so wide a reputation as the goods themselves. The wood generally used in making trugs is willow for the boards and ash for the rims and handles; but there is no reason why they cannot be made entirely of ash, except that it is harder to work, and, on the other hand, small trugs are often made of the willow throughout. The variety of willow most sought after for the purpose is a special soft kind called sallow willow.

The tools needed are very few indeed, the saw, hammer, and draw-knife being the principal ones. In addition to these there is required an appliance for holding the wood while it is manipulated, and one for steaming the rims and handles to make them bend to shape. The former cannot very well be dispensed with, but as it is extremely handy for a variety of uses besides the one now being dealt with, the time and material used in the making of it will not be thrown away, even if only one or two trugs are made. In the case of the steaming apparatus, use can be made of hot water only for a small job, and the whole arrangement can easily be fitted up if it is preferred to do so later on, and as the cost is not much, instructions on fitting up the entire plant are here given. The trugs are, as a rule, made double the length in relation to the width, and the one used as an illustration for this article is 27 in. long by 13½ in. wide, while the handle is shaped so that it is the same depth as it is wide; but the upper or handle part is bent slightly different from the lower part which forms the bottom of the trug.

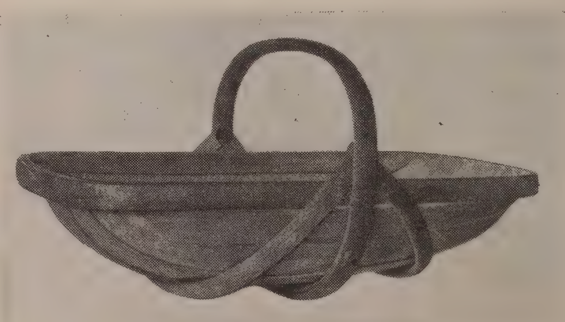


Fig. 1.—Gardener's Trug

For a trug of the above size the rim will have to be 7 ft. long and the handle 4 ft..

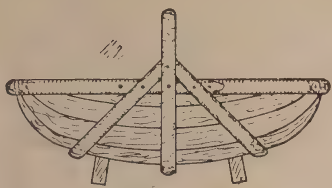


Fig. 2.

Fig. 3.

Figs. 2 and 3.—Side and End Elevations of Trug

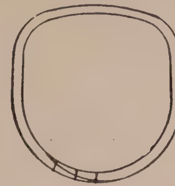


Fig. 14.—Handle Bent and Spliced

Fig. 7.—Cleavage Running Astray

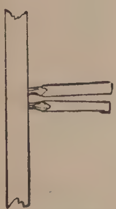


Fig. 5.

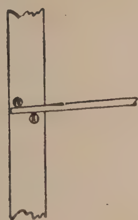


Fig. 6.

Figs. 5 and 6.—Side and Front Elevations of Cleaving Brake

Fig. 4.—Section of Pole for Strips

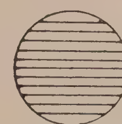


Fig. 8.—Willow Pole to be Cleft

Fig. 9.—Strip Shaved for Splicing

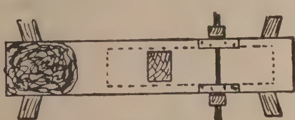


Fig. 17.

Fig. 15.—Foot for Trug

Fig. 16.

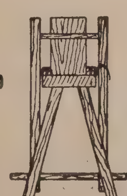


Fig. 18.

Fig. 19.

Figs. 16, 17, 18 and 19.—Side Elevation, Plan and Front and Rear End Elevations of Shaving Horse

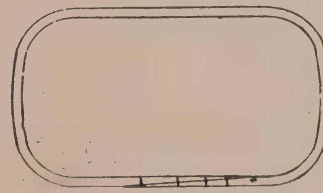


Fig. 13.—Rim Bent and Spliced

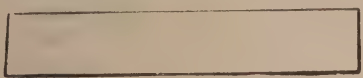


Fig. 10.

Fig. 11.

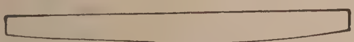


Fig. 12.

Figs. 10, 11 and 12.—Approximate Shapes of Middle, Second and Top Boards

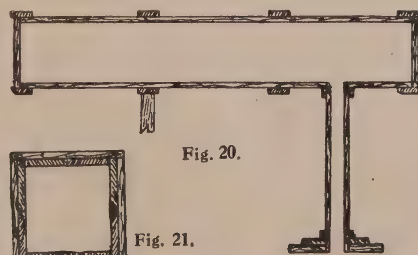


Fig. 20.

Fig. 21.

Figs. 20 and 21.—Longitudinal and Cross-section of Steam Box

these lengths including sufficient wood for the lapped splicings, as shown in Fig. 13. These strips, which, as stated above, should be of ash, are formed in their rough state by cleaving an ash pole some $2\frac{1}{2}$ in. in diameter into quarters, and then shaving off the sharp corners with the draw-knife, also making the tapered-off ends for the splicings at the same time. The boards are cleft out as thinly as possible from the lengths of willow pole, which may be from 3 in. to 4 in. in diameter for this size of basket, and must be cut into lengths of 34 in.

Begin with the rims and handles, the forming of which will be made easier by means of the photograph of the finished trug (Fig. 1) and the side and end elevations (Figs. 2 and 3). Fig. 4 shows the section of the ash pole from which the rim and handle are to be made, the shaded portions showing the waste, which will eventually be cut away with the draw-knife. The correct tool for cleaving out the pole is a cleaving axe; but for present purposes the ordinary handbill can be used, driving it in at the proper place with a piece of wood, and splitting the wood by using the tool itself as a lever. It will be found that in the hands of a novice the wood will tend to split unevenly, although the theory is that it should follow the pith. This is what it should do, but it will only do so if handled properly, and Figs. 5 and 6 show the necessary appliance to carry this out. The two pegs are driven into a convenient post as shown, at a height of about 4 ft. from the ground, one being slightly higher than the other. The pole being cleft is placed between them, as in Fig. 6, when by putting a slight pressure on the end the cleavage will run downwards. Thus if the work is proceeding as in Fig. 7, the bottom piece will run out to a thin edge; but if the pole is placed in the "brake" (Figs. 5 and 6) with the *thicker* part downwards, and this part slightly bent down, then the split will right itself, and the two pieces finish equal in size.

The strips must now be "shaved" to shape with the draw-knife, the ends being sloped off for a length of about 8 in. to form the splice, and at the same time the rough parts left in cleaving must be trimmed off. With the exception of the one sloped end, *the bark must be left intact*, otherwise it will be difficult to form the bends successfully. The boards will be cleft out in the same way, but as there is not the same chance of guiding the cleavage in this case, it is best not to attempt to cleave them too thin, especially at the first attempt. Fig. 8 shows the end of the length of willow ready for cleaving out, and Fig. 9 shows how the ends of the rim and handle strips must be sloped off to form the splicing. The boards will have to be finished in width to suit the position they will occupy in the finished trug, thus the middle board should be almost or quite parallel, as in Fig. 10, the next boards at each side will come more like Fig. 11, and the next something like Fig. 12. That is providing there are five boards only, but it is best in a trug of the size being dealt with to use seven boards. In all cases the number of boards must be an odd one, so that the first one to be fixed comes flat in the bottom.

To put the rims together after steaming the strips, they must be bent over a pole or something equally convenient so that the corners are as symmetrical as possible, and so that the splice comes in the middle of one side, as in Fig. 13, and in bending them the bark must be on the *outside*. The splicings are nailed at once, driving the nails through from the outside, and resting them on an old flat-iron or something similar, so that the nails are clinched firmly at the same time as they are driven.

The handle is put together in the same way, noting that while the bottom part (where the splicing must be) is bent to a semicircle, the upper (or handle) part is bent more sharply at the corners, thus giving a better hand-grip. Although these rims and handles are bent and put together by the eye only by those who are making them regularly, it is advisable for the novice to use a board shaped to the inside of each, so that the strips can be bent round the edges; and if an iron plate is inserted where the nails will come in fixing the splicings together, the clinching

will be done at the same time, the same as though the operations were done in the regulation manner. Fig. 14 shows the handle bent and spliced.

After the rims and handles are formed, the two need nailing together at right angles, and then the frame is ready for the boards. The middle one of these is fixed first by a single nail in the middle into the bottom part of the handle portion. The board is then bent down with the hands to the required curve, and nailed at the ends, driving the nails through so that they are clinched on a piece of iron. Each board is put in in the same way, bending them so that they bed evenly on the one previously fixed, and nailing them first in the middle and then to the rim at the ends. After all the boards are fixed, the ends which project above the rim are trimmed off with a sharp knife. It will be noticed that the trug in the photograph is fitted with diagonal braces, while that in Fig. 2 has both braces and feet. This latter is done to show both styles in one illustration. In practice, the trug being dealt with would have braces only, the smaller sizes having these omitted, but feet being fixed instead.

The braces consist of strips prepared in the same way as the rim strips, nailed to the rim and tucked inside the handle and nailed there. The boards are also nailed to them from the inside of the trug. The feet are shaped like Fig. 15, and are fixed by nailing into them from the inside.

A brief description of how the special shaving horse and steaming apparatus are made will now be given. The former is shown in side elevation by Fig. 16 and in plan by Fig. 17, while Figs. 18 and 19 show end elevations from the front and seat ends respectively. The main part consists of a stool some 4 ft. 6 in. long, about 1 ft. 8 in. high, and some 9 in. wide at the top. At one end is formed a padded seat for comfort's sake, and at the other is fixed the sloping board as shown, also the swinging frame. This latter is pivoted to the seat by the iron bolt shown, which is held in place by the two fillets of wood shown in Fig. 17. The frame has a cross-bar near the top end and another near the bottom end, the latter projecting 3 in. at each side. These bars answer the double purpose of holding the frame together, and the upper one of holding the work while using the draw-knife, and the lower one by the user placing his feet on the projecting ends and thrusting that end of the frame from him, causes the top bar to grip the work on the sloping board. It will be seen that the more pressure needed in the use of the draw-knife the more pressure is put on the work to hold it firm.

The steaming apparatus is shown in longitudinal section by Fig. 20, and in cross-section by Fig. 21. At the bottom of the illustration is shown the lid of a copper used for washing purposes. This has a hole cut in the middle some 3 in. square, and from this rises a hollow shaft, which supports a box of sufficient length to take any length of strip likely to be required. This box may be 9 in. square on the inside, and may be made quite roughly, the boards being held together by ledges as shown. One end is a fixture, but the other must be removable, being fixed in place with two buttons while the steaming operations are taking place. The front of the box must be supported by an upright of some description as shown.

The steaming is carried out as follows: The copper is filled with water and boiled up in the usual way, and while this is being done the box may be filled with the strips to be steamed, when as soon as the water boils the steam, instead of escaping, passes up into the box and thoroughly softens the wood, so that it will bend anywhere and in any way as required. The strips only need to be steamed, the boards will bend without it, and it may be mentioned that they must be shaved very thin, especially at the ends, so that they bend freely without fracture. Three-ply wood is not suitable for trug-making. It might do to a certain extent as regards the actual making, but at the first exposure to damp the trug would fall in pieces in no time. Flat-headed nails must be used; any other kind would pull through the soft wood.

Fig. 22.

Fig. 23.

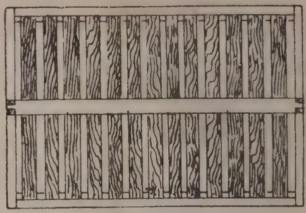


Fig. 24.

Figs. 22, 23 and 24.—Side and End Elevations and Plan of Sprouting Box

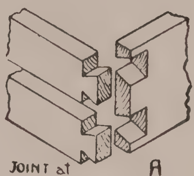


Fig. 25.

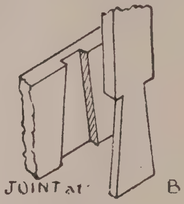


Fig. 26.

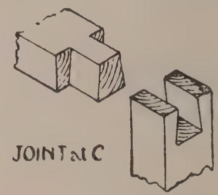


Fig. 27.

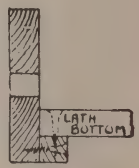


Fig. 28.

Figs. 25, 26, 27 and 28.—Details of Joints of Sprouting Box

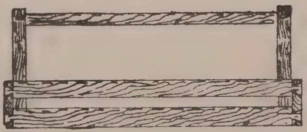


Fig. 29.

Fig. 30.

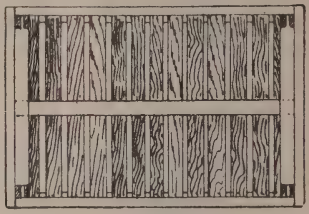


Fig. 31.

Figs. 29, 30 and 31.—Side and End Elevations and Plan of Alternative Sprouting Box

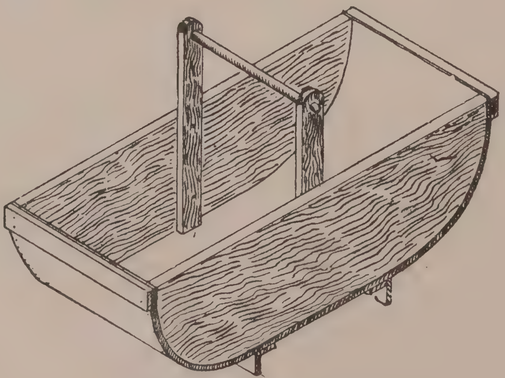
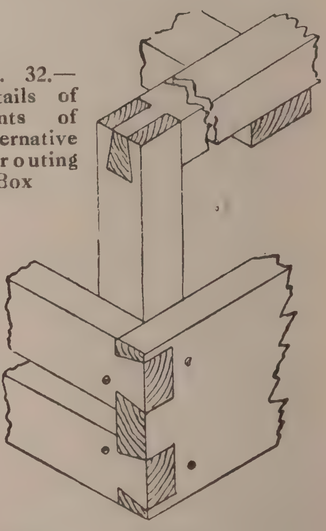


Fig. 33.—Potato Carrier

Fig. 32.—Details of Joints of Alternative Sprouting Box



POTATO CARRIERS

Figs. 22, 23, and 24 give elevations and plan of a sprouting box and collector, most of which is made of strips of wood, roofing tile laths $1\frac{1}{4}$ in. by $\frac{3}{4}$ in. in section being useful for this purpose. To make a box of strips is to make it light and to save material. It also allows a current of air all round the tubers.

When using comparatively small strips of wood, great reliance has to be placed on the joints. In the instance here given dovetail joints are used, these being the most suitable for strength and durability. It will be noticed that the bottom is so arranged as to secure the greatest resistance to the downward pressure of any weight of potatoes that may be placed on it. The bottom rests on side laths which are screwed to the sides, and the bottom laths are placed across the box to gain the greatest strength. Figs. 25, 26, and 27 give the details of the joints at A, B, and C respectively. Fig. 28 is a cross-section of the side, showing the lath supporting the bottom screwed to the side.

One drawback to this box or carrier is that if several are needed they cannot be packed one on another and so save space. Figs. 29, 30, and 31 give elevations and plan of a box made so that they can be so placed. The ends of both boxes are not made of laths, but all the rest of the box consists of laths alone. In Fig. 32 is given an enlarged detail showing the construction of the box.

The potato and general carrier shown by Fig. 33 is very useful. The bottom is of strong linoleum nailed or screwed to the sides. It is especially useful for gathering a daily supply of vegetables.

The scale to which Figs. 22, 23, 24, 29, 30, 31, and 33 are made is given, so that little difficulty will be experienced in getting the sizes. It can be understood that these sizes can be varied to meet individual requirements, although the weight that can easily be carried will limit the size in its outward dimensions.

Trellises, Porches and Arches

MAKING AND FIXING TRELLIS WORK

SAWN laths, such as are used for plaster work, are very suitable for the construction of treillage. These laths are sold in bundles of 500 foot lengths and are obtainable from any builders' merchant. The size of trellis work panels is optional, but convenient sizes are as follow. The square mesh (Fig. 1) 2 ft. wide and of any length required; 45° mesh (Fig. 2) in panels 5 ft. by 2 ft. 6 in.; 60° mesh panels 4 ft. by 2 ft. 6 in., and 70° mesh 6 ft. by 2 ft. 6 in.; the longest laths required in each panel being in order 3 ft. 6 in., 4 ft. 6 in., and 6 ft. 6 in.

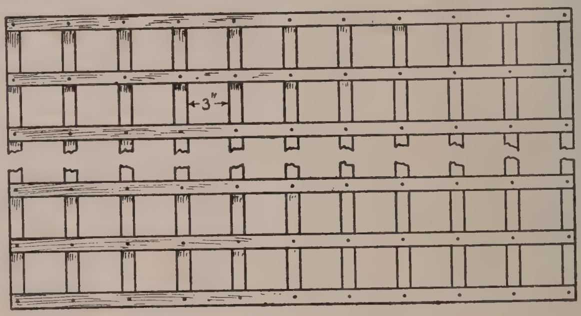


Fig. 1.—Square Mesh Trellis

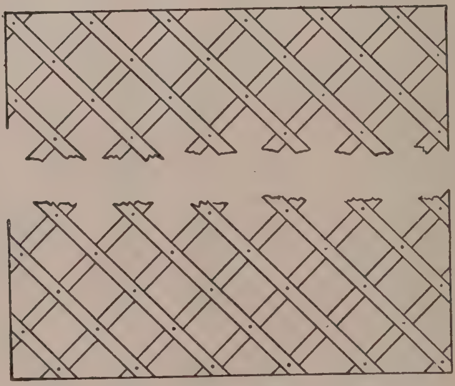
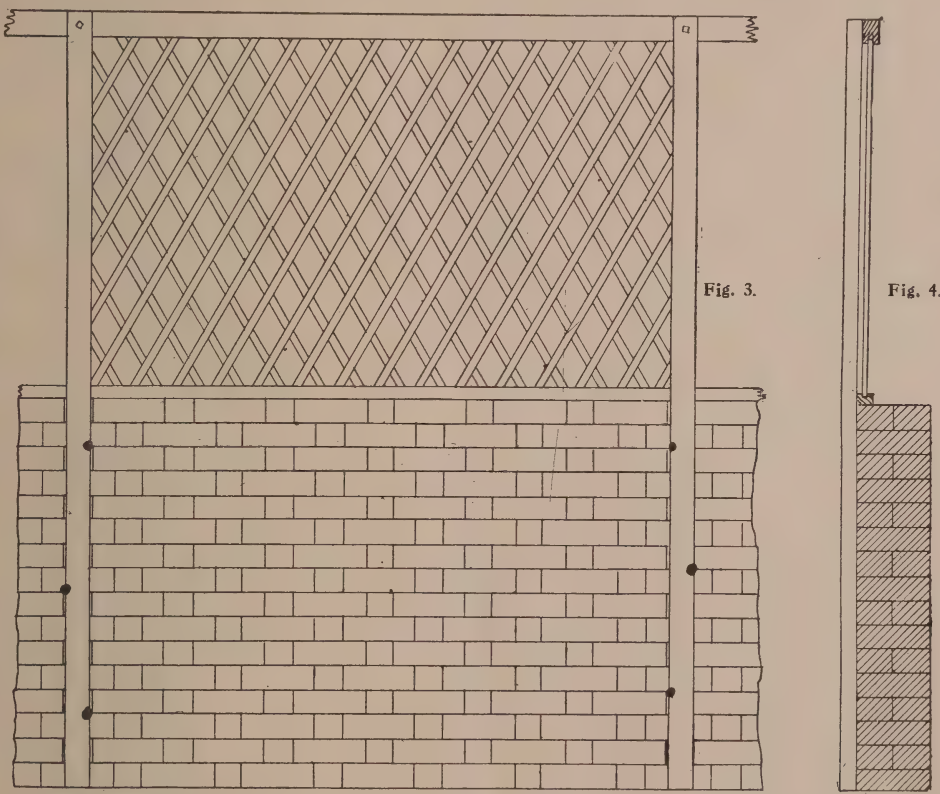


Fig. 2.—Diamond Mesh Trellis

For a quick method of construction obtain four well seasoned and thoroughly dry boards, the size of the panels, and not less than $1\frac{1}{2}$ in. thick. Cut them quite square and set out the meshes on the face to Fig. 1, allowing 3 in. spaces apart. Grooves are now sunk to the transverse line $\frac{3}{8}$ in. deep; cut into the lines to allow a little play for the lath. The longitudinal

grooves are sunk $\frac{3}{16}$ in. only. Fill in the transverse grooves with $\frac{7}{8}$ in. hoop-iron drilled, countersunk and screwed to the woodwork. Then place the laths in transverse grooves and follow with the longitudinal ones above them. Nail each centre with $\frac{1}{2}$ in. trellis pins. The hoop-iron underneath the laths serves to clinch the pin as it is driven home. The the wall about 6 ft. apart by means of wall hooks, as shown in Fig. 3. A top rail of the same size wood is fixed to the posts by bolts. A plough groove on the underside of this rail, as shown in Fig. 4, will be an advantage. For the lower part of the framework a piece of wood about 2 in. by $1\frac{1}{2}$ in. will do to fix on the top of the wall (*see* Figs. 3 and 4).



Figs. 3 and 4.—Front and End Elevations of Trellis Fixed to Wall

projecting laths at the end and sides may now be cut off and the panel removed and folded up. Panels of each kind of mesh may be set out in a similar manner.

Trellis work is erected on a garden wall by providing a suitable framework of desired length and height. To make the framework obtain some pieces of red deal about 3 in. by 2 in. and fix same to

GARDEN ARCH

It may be worth while to point out the rather meaningless nature of very many garden arches of every type which are constantly seen standing isolated from all immediate surroundings and serving no real purpose, and it is contended if such arches can be made part of some feature

in a more or less comprehensive scheme, the effect is likely to appear more coherent and complete.

The central arch portion of the one under consideration (Fig. 5) consists first of all of four upright posts $1\frac{1}{2}$ in. square and 8 ft. $10\frac{1}{2}$ in. long, one end of each being pointed and well tarred ready for bedding in solid ground. The top end has a "notch" 1 in. wide and $1\frac{1}{2}$ in. deep taken out of it, as figured in Fig. 6. This notch is intended to receive the end of one of the two cross-pieces C (Fig. 6) and D (Fig. 7) $2\frac{1}{2}$ in. deep and $1\frac{1}{2}$ in. wide, with their ends cut to the outline suggested at E in Fig. 8. The dotted line in this figure indicates the end of the upright where partly cut away to receive the cross-piece, under the overhanging end of which is fixed a shaped bracket cut out of $\frac{7}{8}$ in. stuff 12 in. long and 3 in. wide, as at F in Fig. 8 and as dotted in Fig. 6, this being merely firmly bradded in the position there shown.

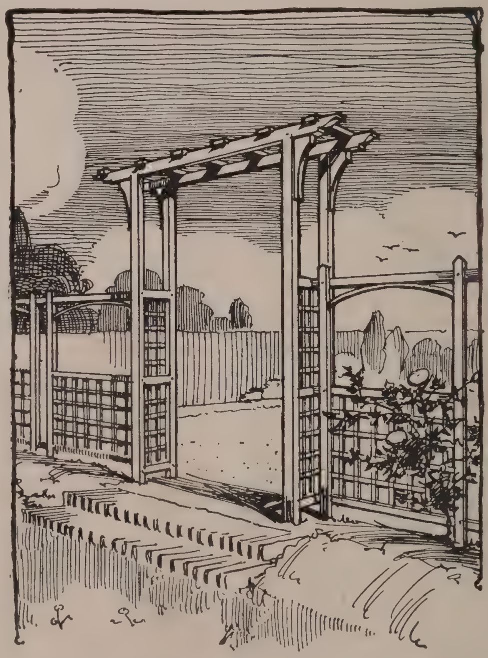


Fig. 5.—Garden Arch and Dwarf Screen

The couple of upright posts on each side of the arch are kept at a distance of 12 in. in the clear, by means of three short rails, G, H, and J in Fig. 9, $1\frac{1}{2}$ in. square, and notched and splayed at their ends, as shown in plan by Fig. 10, where the shaded squares, of course, represent the posts. This is probably the very easiest joint possible to form, although quite efficient in such a case when properly nailed or screwed. It will be readily gathered from Figs. 7 and 9 that the rail G is about 4 ft. 6 in. above the ground level, J only about 6 in., and H midway between the two others. Either one or both of the lower rectangular spaces to the sides of the arch may appropriately be filled in with trellis, if possible of the square rather than the diagonal variety. This square treillage can be made from plasterers' laths, and will complete the arch with the exception of a series of six light strips fixed across the two cross-pieces on the top, as indicated on the various figures.

Dealing next with the simple screens at the sides of the arch, it is proposed to adopt for these an even more elementary form of construction. They are intended to consist of uprights some 5 ft. 6 in. long arranged in pairs 3 in. apart, except next the arch, where a single upright will be observed, and they will be set out at about 3-ft. intervals right across the garden. They can be made of practically any very light stuff, and should have three horizontal rails of the same size running across them, as in Fig. 7, level with the rails G, H, and J (Fig. 9). The fixing here depends not even on a simple joint such as that previously described for the arch, but entirely on the nailing or screwing at these points of crossing. On the lower portions of this framework it should be found quite straightforward to fix trellis such as that indicated.

A curved member at the top, as at K in Fig. 7, is a distinct improvement. It can be contrived with a length of pliable cane bound in position with wire, and will help to carry the climbing roses, etc., round to the top bar or rail.

The whole of the work should be thoroughly protected from the effects of sun

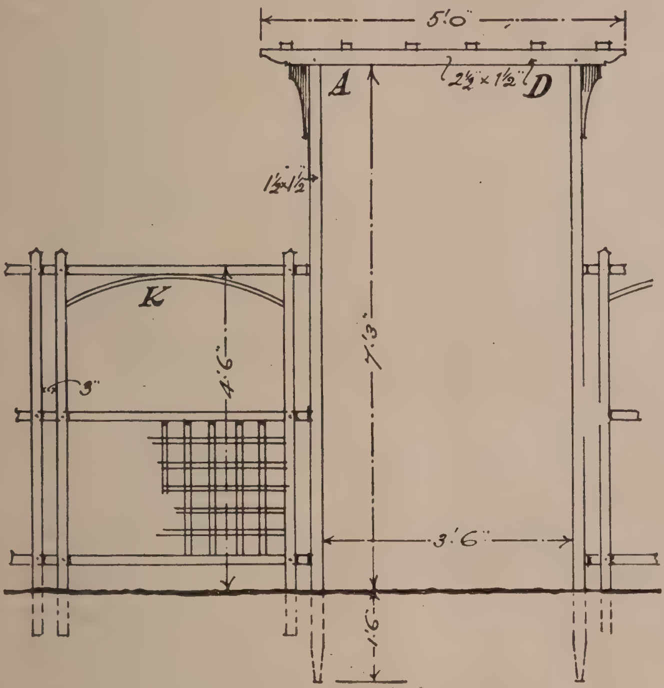


Fig. 7.—Front Elevation of Arch and Part of Screen

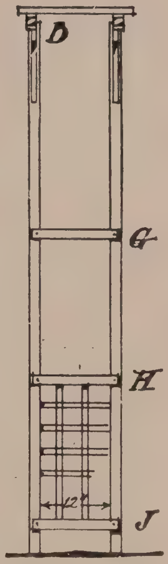


Fig. 9.—Side Elevation of Arch

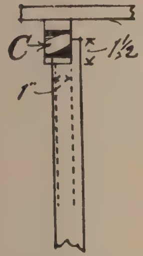


Fig. 6.—Detail at B (Fig. 9)

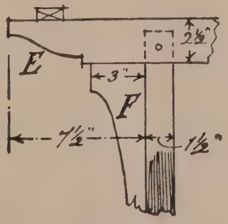
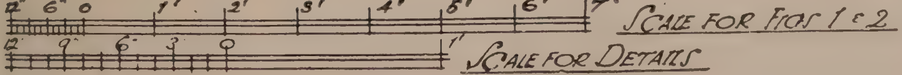


Fig. 8.—Detail at A (Fig. 7)

Fig. 10.—Plan of Two Screen Uprights



and rain by a sufficient coating of paint or creosote.

TRELLISED ARBOUR

The line drawing (Fig. 11) shows a scheme for a simple structure which can be kept merely as a trellised arbour, as shown, or developed into a summer-house, by filling in the sides with boarding and putting a felted roof. Most of its effectiveness depends on the flanking arches with which it is combined, and the whole will afford opportunities for a fine display of roses or other climbers. A device of this sort is especially suitable for the comparatively narrow garden plot, which is always increased in apparent extent by transverse screens; or the same idea could be introduced in several other positions.

It is not essential that the two arches should be especially made for this scheme; they can equally well be of the ordinary wire, trellis, or "rustic" types, and either round or pointed. Their distance apart will, of course, depend on the total width of available ground, the dimensions given in the figures being in the nature of suggestions. The arbour itself also can be of either larch or other straight unwrought poles, stout for the framework and small for the filling-in; or the whole would look well in squared and painted or stained stuff for the framework with planed trellis between. Carefully fixed together at the various joints, it will be found that no halving, etc., is necessary.

Figs. 12 and 13 are respectively skeleton elevation and plan to show the proposed arrangement of the work, while the suggested sizes can be obtained from Figs. 14 and 15, these being a half plan and cross-section. Fig. 14 gives lengths enabling the sloping sides to be set out, and also the main uprights A and B, which should be very firmly bedded in the ground, with concrete or bricks round them if necessary. They are splayed at the top to receive a head as at C (Fig. 15), which will later serve to take a series of light horizontal battens to form the roof. A sill D and rail E are also fixed along the sides and back, and filled in with uprights from top to bottom. The lower panels are finished with lattice work of some description, and the whole requires very thoroughly painting or treating with some efficient preservative.

The seat introduced could be based on one of the numerous designs shown and described on other pages of this work,

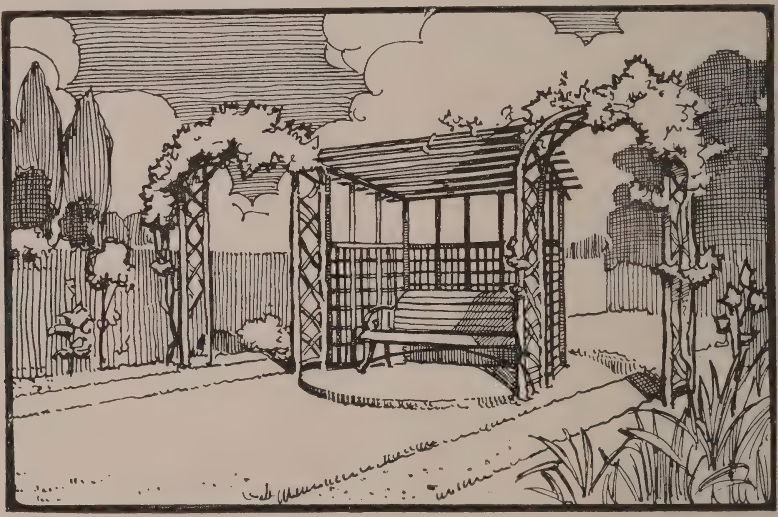


Fig. 11.—Trellised Arbour

and it will be found a great improvement if the floor of the arbour is paved with concrete or gravel, arranged slightly sloping so that water will not accumulate, and brought out to a curved step or riser along the front, which could be finished with bricks set on edge

have a striking effect in any garden, even if it was not erected for either of the definite objects mentioned. The screen could be altered and adapted to meet individual requirements. For instance, the arch and gate could be omitted, or the arch could be included and the gate omitted,

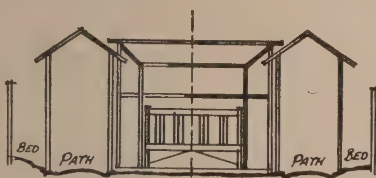


Fig. 12.—Elevation of Framework of Arbour

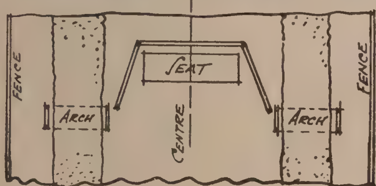


Fig. 13.—Plan of Arbour

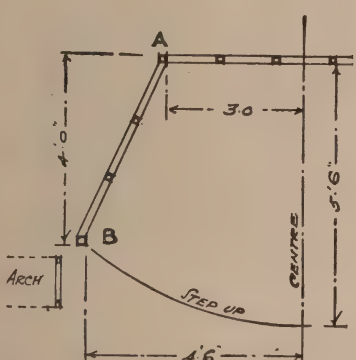


Fig. 14.—Half Plan of Arbour with Dimensions

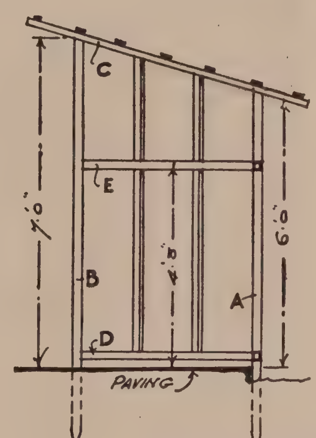


Fig. 15.—Detailed Transverse Section of Arbour

TRELLIS ARCH AND SCREEN

The trellis arch and screen shown by Fig. 16 could be used for many purposes in the garden, such as for hiding an unsightly part, and when covered with climbing plants would prove an effective screen. Or it could be used to divide the flower and kitchen gardens, while a piece of ornamental woodwork of this description would while the dimensions which are given could be varied. Oiled or varnished oak could be used in making the screen; but painted deal could be used if desired, and would give a very fine effect if painted white.

The upright posts for the side portions of the screen (Fig. 17) are 7 ft. 6 in. long, this allowing a length of 1 ft. 6 in. for sinking into the ground by $2\frac{1}{2}$ in. thick by 2 in. wide. The upper connect-

ing rails are 3 ft. 10 in. long by $2\frac{1}{2}$ in. thick by 2 in. deep, and they are shaped as shown, being compassed about 4 in. The lower connecting rails are 3 ft. 10 in. long by 2 in. deep by $1\frac{1}{2}$ in. thick. The upper connecting rails are mortised and tenoned into the uprights, as shown by Figs. 18 and 19, and the lower connecting rails are mortised and tenoned into the uprights, as shown by Figs. 18 and 20. These joints when they are finally fixed should be well painted and secured with wood pins. The rails which form the trellis are 1 in. wide by $\frac{1}{2}$ in. thick in section, and the horizontal rails are fixed 8 in. apart, the perpendicular rails being fixed 4 in. apart. The horizontal rails are mortised into the uprights, as shown by Fig. 21, the outer faces of the rails being kept level with the outer faces of the lower connecting rails. The perpendicular rails are mortised into the upper connecting rails, as shown by Fig. 22, and are nailed to the lower connecting rails, while the horizontal and perpendicular rails are nailed together, as shown by Figs. 21 and 22. The tops of the uprights should be finished with wooden caps, which should be about 4 in. square by $\frac{1}{2}$ in. thick. Small tenons are formed at the top ends of the uprights, suitable mortises being cut in the caps, and by this means the caps are fixed in position.

The uprights for the arch are of a similar section to the uprights at the sides. The upper cross rail is 3 ft. 10 in. long by $2\frac{1}{2}$ in. thick by 2 in. deep, and is shaped as shown, while the lower cross rail is 3 ft. 1 in. long and of a similar section. The lower cross rail is tenoned into the uprights, and the uprights are tenoned into the upper cross rail, as shown by Fig. 18. The small upright rails which are framed between the upper and lower cross rails are 1 in. wide by $\frac{1}{2}$ in. thick in section, and they are mortised into the upper and lower cross rails, as shown by Fig. 18.

The gate is framed up with two sides rails and top and bottom rails (Fig. 23). The side rails are 3 ft. $4\frac{1}{2}$ in. long by $2\frac{1}{2}$ in. thick by 2 in. wide. The top rail is 2 ft. 9 in. long by $2\frac{1}{2}$ in. thick by 2 in. deep, and is compassed about 4 in., and the bottom rail is 2 ft. 9 in. long by 2 in. deep by $1\frac{1}{2}$ in. thick. The top and bottom rails are framed into the side rails with mortise-

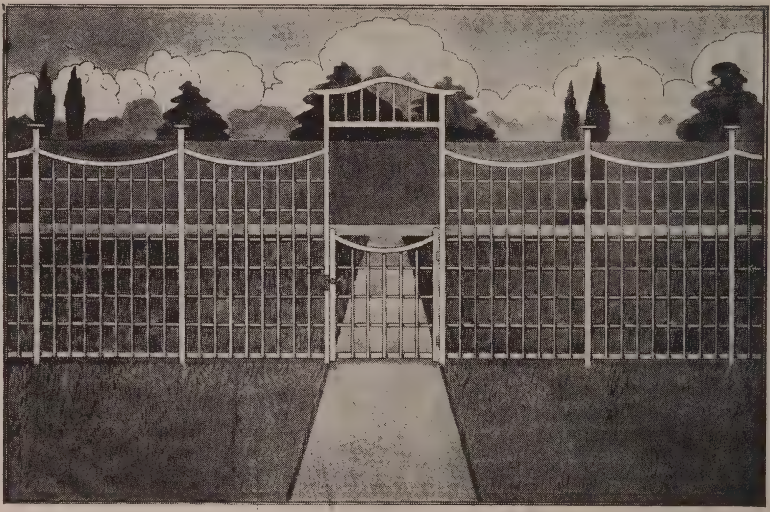


Fig. 16.—Trellis Arch and Screen

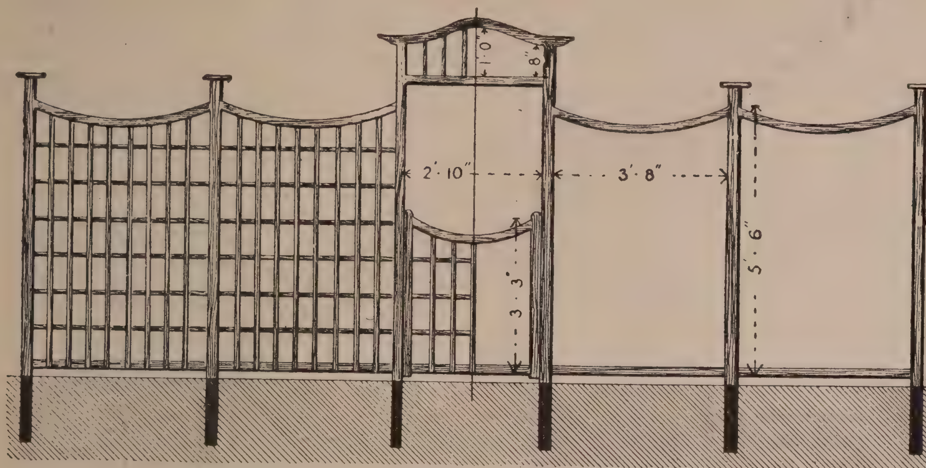


Fig. 17.—Front Elevation of Trellis Arch and Screen

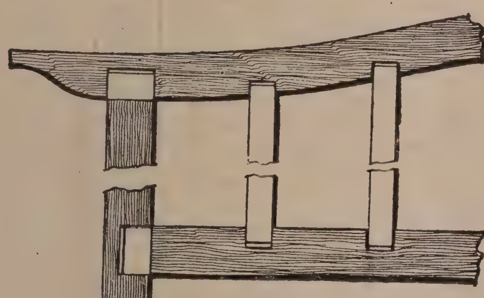


Fig. 18.—Detail of Framing of Arch

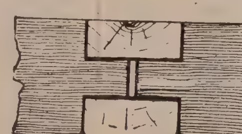


Fig. 19.—Method of Fixing Upper Rails

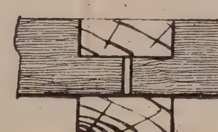


Fig. 20.—Method of Fixing Lower Rails

Fig. 21.

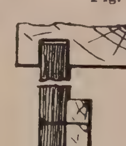


Fig. 22.

Figs. 21 and 22.—Method of Mortising Horizontal and Perpendicular Connecting Rails

Fig. 23.—Detail of Framing of Screen and Gate

and-tenon joints, as shown by Fig. 18, and the small rails which form the trellis are fixed in a similar manner to those in the sides of the screen. The gate should be hung with butt hinges, and fitted with a suitable latch of the garden gate variety.

In fixing the screen, holes must be prepared in the ground for the reception of the lower ends of the uprights, and when the screen is in position the earth must be well rammed in round the uprights. It will be well to give the parts of the uprights which are sunk into the ground a coat of tar or thick paint.

SIMPLE COTTAGE PORCH

In the choice of a design for a porch there are many from which to choose, such as the close porch with glass sashes, the rustic porch, and the open porch with wrought timber. The porch here shown (Fig. 24) is entirely made of wood, and covered with a piece of waterproofing material on the top. Front and end elevations and plan are shown by Figs. 25, 26 and 27 respectively.

Fig. 24.—Cottage Porch

Any kind of wood is suitable for this piece of work. Red, yellow, or even white pine might be used for cheapness. Hardwood would be very suitable; but, as a rule, it is difficult to work, and is expensive. Of course, if there is no objection to the cost, a teak, mahogany, or oak, varnished, porch would look very well. The material required is: Two front posts, 7 ft. by $2\frac{1}{4}$ in. by $2\frac{1}{4}$ in.; two back posts, 7 ft. 3 in. by $2\frac{1}{4}$ in. by $2\frac{1}{4}$ in.; four rails, 1 ft. 4 in. by $2\frac{1}{4}$ in. by $2\frac{1}{4}$ in.; two top rails, 2 ft. 3 in. by $2\frac{1}{4}$ in. by $2\frac{1}{4}$ in.; one bracket, 1 ft. by 6 in. by 1 in.; six pieces for lower panels, each 3 ft. 3 in. by 1 in. by 1 in.; for the lattice panel, 44 ft. of $1\frac{1}{4}$ in. by $\frac{3}{8}$ in.; and for the roof, 4 ft. 3 in. by 2 ft. 3 in. by 1 in. Six holdfasts about 5 in. long, as shown in Fig. 28, and a piece of tarred felt to cover the roof are also required.

Plane the wood on the face and edge, and then gauge for the thickness and breadth. The planing should now be completed, taking care that each piece is perfectly square and that the surfaces are true. The piece for the top should be planed on both sides, but it is just possible that it will only be procurable in two pieces 15 in. fully wide, when it would require to be jointed where the two pieces meet. Plane up the four edges, and fit together the two parts forming the joint. Put two dowels $\frac{3}{8}$ in. in diameter in the joint. These circular pins are 3 in. long, and are fitted in for $1\frac{1}{2}$ in. into corresponding holes bored in the edge of the joint. The dowels should fit tightly, as

the firmness of the joint between the two boards depends on that for the holding together.

If a long flooring board can be procured, the top part of the roof could be formed out of this, and would save the making of special joints. Plane the flooring board on the face, and make small chamfers on the joints, which will give the underside of the roof a very pleasing appearance.

The parts of the framing should be marked off in pairs. This is best done by marking the face of each piece and also the inner edge. Bring together the two pairs of posts, and mark off the positions of the bottom and middle mortises. Square the marks on both edges, and mark the thickness of the tenons on the mortise spaces. Lay one of the front and back posts on the top of the bench, as if in position to form

Fig. 25.

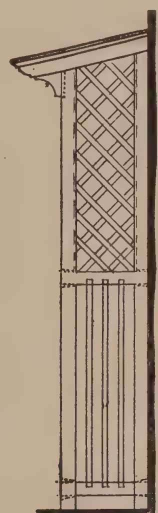


Fig. 26.

Figs. 25 and 26.—Front and End Elevations of Cottage Porch

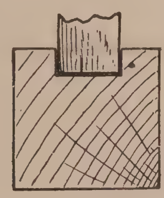


Fig. 29. — Detail of Vertical Intermediate Rail

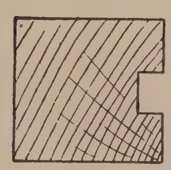


Fig. 30.

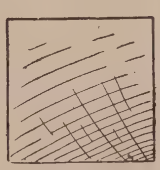


Fig. 31.

Figs. 30 and 31.—Sections of Post

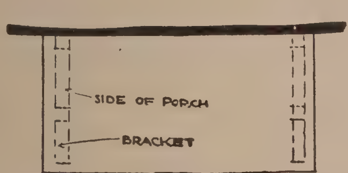


Fig. 27.—Plan of Cottage Porch

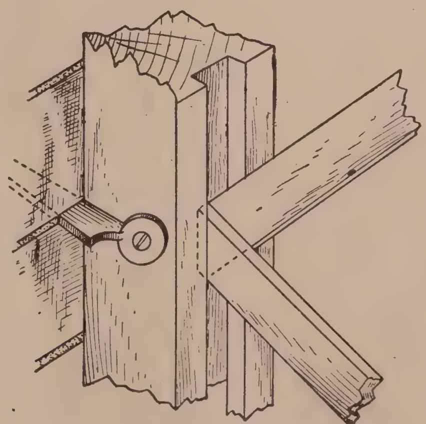


Fig. 28.—Method of Fixing Porch

Scale of Figs. 25 to 27 : 1 in. = 3 ft.

the side of the porch. Lay the top rail in position at the head of the posts, and mark off the position of the tenons on the ends of the posts and the two mortises on the top rail. The lengths of the mid and bottom rails are marked off in the same way as the post, with the addition that the mortises are set out for the small posts in the lower panel.

The mortises can now be cut out. The mortises on the lower mid and top rails are only cut halfway down. In tenoning cut the shoulders of the joint first, then form the tenon on the cross rails. The vertical intermediate rail has no tenons, these being housed in both ends, as shown in Fig. 29. The next part of the work is the cutting of the groove for the lattice panel and the shaped bracket at the top of the post. A section of the post below the lattice pattern is shown by Fig. 31, and a section with the groove by Fig. 30. These grooves are only cut out on the posts, the mid and top rails being left plain. Mark off the grooves with a scratch gauge, and mortise out with a chisel, and finish with a rebate plane. There is no reason why a plough should not be partly used to form this work.

The top rails having been already mortised are now marked off for the ornamental end. Set off from the outer mortise the breadth of the shaped bracket, then ½ in. for a projection beyond the bracket, and add 3 in. for the moulded end. The curved edge is cut with a fine bow-saw, after which it is pared and glasspapered. The cutting of the shaped brackets is shown, the marking off having been done on both sides of the wood. Finish the curved edge with the spokeshave, and rub with glasspaper.

In fitting together the framing, each of the inner edges of the posts should be cleaned off and glasspapered, after which the edges of the rails and the vertical division pieces can be planed all round. In putting together, fit the division pieces into the rails. Then turn this part into a horizontal position, and fit into the post as shown. The outer post is then placed in position, when the two posts are drawn close together, and are fixed by driving wedges into the mortises at each side of the tenons. The top rail for the roof is now fitted on to the ends of the posts, and the bracket nailed in position. All these joints should be put together with paint, each part being well coated, and the wedges dipped into the paint before being driven into the joint.

In fitting the lattice panel, arrange the frame of the side of the porch on the bench, then place the strips of wood for the panel in position. Mark the length of each piece by drawing a line on both sides top and bottom, using a wooden straightedge as shown. The various strips for the panel are now cut to the lines set off, when each is fitted into the grooves in the posts and nailed.

In fitting up the porch, the wood framework should be fixed to the wall of the house with three holdfasts on each side. Of course, the positions of the side frames depend very much on the width of the door; but a very good plan for a small porch is to set up the side frames 3 in. back from the side of the door. Cut out the mortar joint for a depth of 3 in. at the holdfast, fill up with a piece of wood, and drive the holdfasts in position in one vertical line from top to bottom. Each side frame is now fitted to the wall, and the wall post is screwed to the holdfasts.

The roof boarding is then cut to its proper length, cleaned smooth on the ends, and chamfered on the lower arris on the front and both ends. In nailing the boards in position, see that the side frames are at right angles to the wall, and that the projection of the roof boarding is the same on both ends. Cover the roof with a piece of natural asphalt or felt roofing, and if the house front is a brick one, scrape out the first horizontal joint above the porch roof. Put the edge of the felt into the joint, then fold down to form a flashing along the roof to where it is to be tacked along the edges. In painting the porch, rub all the wood well with a piece of glasspaper. Then cover all the knots with knotting, and give the priming coat. Allow it to stand at least one day, then rub down again. Putty all the nail holes, and coat with paint. For the finishing

coats, rub well with glasspaper and coat evenly with white enamel. This may be repeated; but in each case allow plenty of time for the succeeding coat to harden.

COVERED COTTAGE PORCH

The working drawings given comprise front and side views (Figs. 32 and 33), plan above the ground level (Fig. 34), plan looking down on the top (Fig. 35), and enlarged details of the construction (Figs. 36 and 37), which has been kept as simple as possible. The various sizes given can be varied somewhat, but if adhered to the effect will be similar to that shown by the small sketch of the completed porch (Fig. 38).

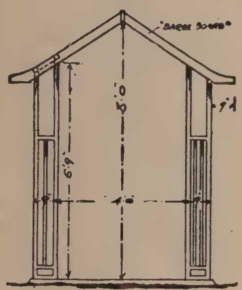


Fig. 32.

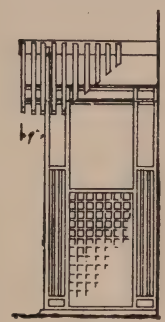


Fig. 33.

Figs. 32 and 33.—Front and Side Elevations of Covered Cottage Porch

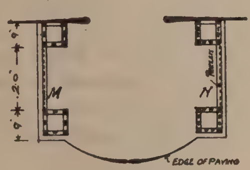


Fig. 34.

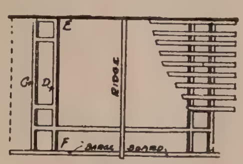


Fig. 35.

Figs. 34 and 35.—Plans at Ground Level and Roof of Porch

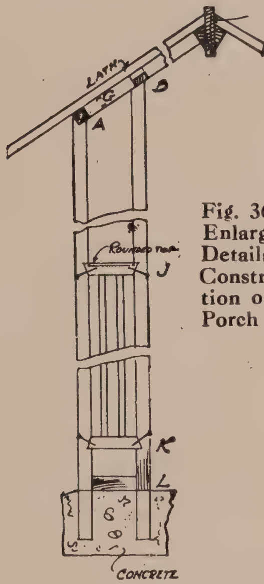


Fig. 36.—Enlarged Details of Construction of Porch

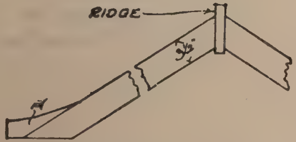


Fig. 37.—Enlarged Details of Construction of Roof of Porch

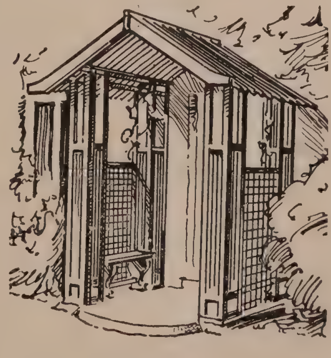
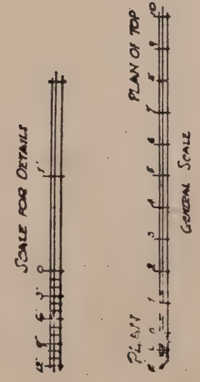


Fig. 38.—Covered Cottage Porch



To ensure stability it is advisable to bed the uprights in a layer of concrete a few inches in thickness, which can be finished smooth on top or with a gravel surface, as preferred. The main structure is composed of four groups of posts, one at each angle, and each formed by four uprights from 1 in. to $1\frac{1}{2}$ in. square. These are shown on the plan (Fig. 34) and the front of one group in detail in Fig. 36, from which it will be seen that the tops are cut out to take two horizontal bearers, as at A and B on the detail and C and D on the plan of top. From the latter illustration it will be gathered that they start from the wall face at E and continue to F, at which point they project 9 in. in front of the uprights below. The short cross-pieces (G on the detail, and which will readily be found on the plan of top) are spiked in position where shown, to keep the bearers at the correct distance apart, while next the front a fourth cross-piece is not stopped against the bearer B like the others, but is halved with it, and continued up to meet the ridge as shown on the detail. This ridge may be 6 in. by $\frac{3}{4}$ in., and is fixed against the wall at one end, and at the other projects about $1\frac{1}{2}$ in. in advance of the bearers described, being supported by the fourth cross-piece on each side. Two rafters or barge boards about $3\frac{1}{2}$ in. by $\frac{3}{4}$ in. are firmly fixed to the ends of the bearers and against the ridge. The detail shows how it is suggested to shape the feet of this portion, by adding a small curved piece as at H.

The roof will eventually be formed either with ordinary trellis or very light laths as shown, to take the upper ends of which triangular pieces should be fixed on the sides of the ridge. Horizontal pieces as at J and K (Fig. 36) should be fitted into the uprights on all sides, the upper ones being 4 ft. 6 in. above the paving and rounded off on top if desired. These will be filled in with square strips, either one or, for preference, two to each side, which will not require mortising, a nail driven in on the slant at each end being sufficient. A sill piece may be inserted next the cement (*see* L), and the sides at M and N (Fig. 34) similarly filled in with a couple of rails to take pieces of trellis as noted, forming a recess on each side of the porch. The trellis may be of the diagonal variety or specially built up of laths at right angles to each other as shown, which would make a superior style of finish.

It should be understood that this is a very light method of construction, not suitable for anything heavier than trellis, for which it is well adapted. There will be no difficulty in arranging the same design to take, for instance, a boarded roof. Rafters about 2 in. by 1 in. may be fixed on top of the bearers A and B.

TRELLISED PORCH WITH GABLE ROOF COVERED WITH WEATHER-BOARDING

The porch shown in Fig. 39 is of picturesque but economical construction. Half front elevation, side elevation, plan and section are shown by Figs. 40, 41, 42 and 43 respectively. The base is composed of a layer of concrete having a slope towards the front so that water will drain off the floor. The corner and door posts are of 3 in. by 3 in. material and are grooved in the lower portions to receive the panels, which latter are made of grooved-and-tongued boarding, as indicated in Fig. 46.

The sills are held in position either by holding down bolts as shown, or by iron dowels. Fig. 47 shows a detail of sill and boarding.

The top of the sides and the front wings are composed of square bars halved together, thus forming open trellis work. The rafters over the front are strengthened by cross bracing, as shown in Figs. 40 and 45. The roof is covered with rebated weather boarding.

The top rails of the sides are continued and bracketed (*see* Figs. 43 and 44) to give support to overhanging gable. A detail of the barge boards is shown in Fig. 48. Seats are formed on each side of the porch, the construction of the supports being indicated in Fig. 42. The porch may be made of any suitable timber, red deal being preferable.

RUSTIC ARCH AND ESPALIER

The resident in a country district will often find ready to his hand a variety of woods, pear, apple, larch, oak, etc., suitable for rustic carpentry; whereas the city dweller may have difficulty in obtaining just what he wants. Whilst almost any wood will answer for temporary work, the best for permanent work is probably larch (*Larix europæa* D.C.: Order *Abietineæ*), whose straight growth specially fits it for the carrying out of decorative designs; it lasts longer in exposed situations than any other ordinary wood—heart of oak only excepted—and probably ten times as long as those portions of the oak that are generally available for garden carpentry. Larch, too, is plentiful; for larch plantations now abound in most districts, and when they are thinned the rustic carpenter should look out for his supply. The poles grown in thick plantations are better for rustic work than those that grow singly, as the former taper more gradually, and have fewer branches. The wood of spruce and other firs which have the same symmetrical growth, has almost as good an appearance, but it has not the lasting properties of

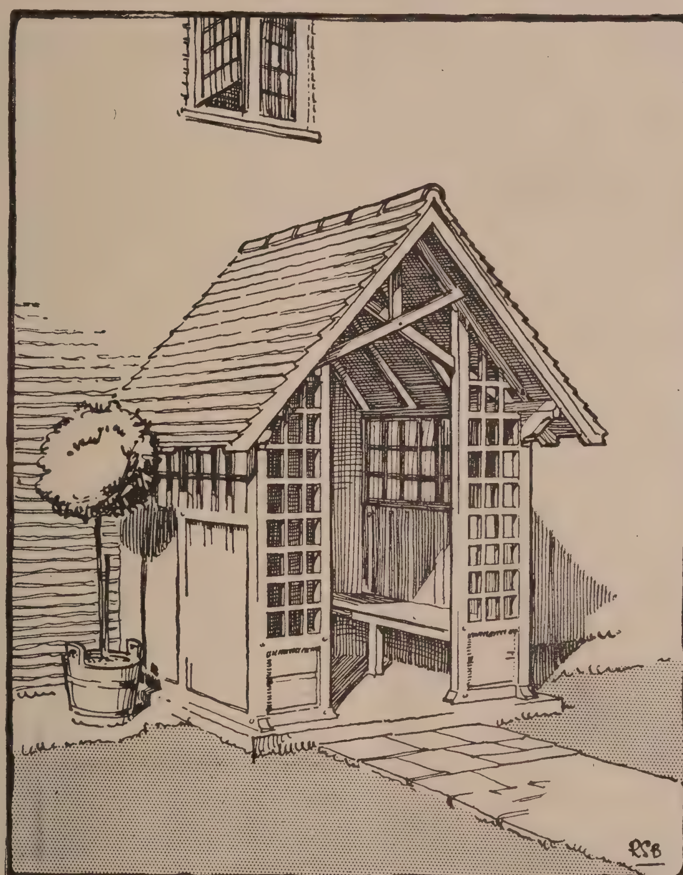


Fig. 39.—Trellised Porch

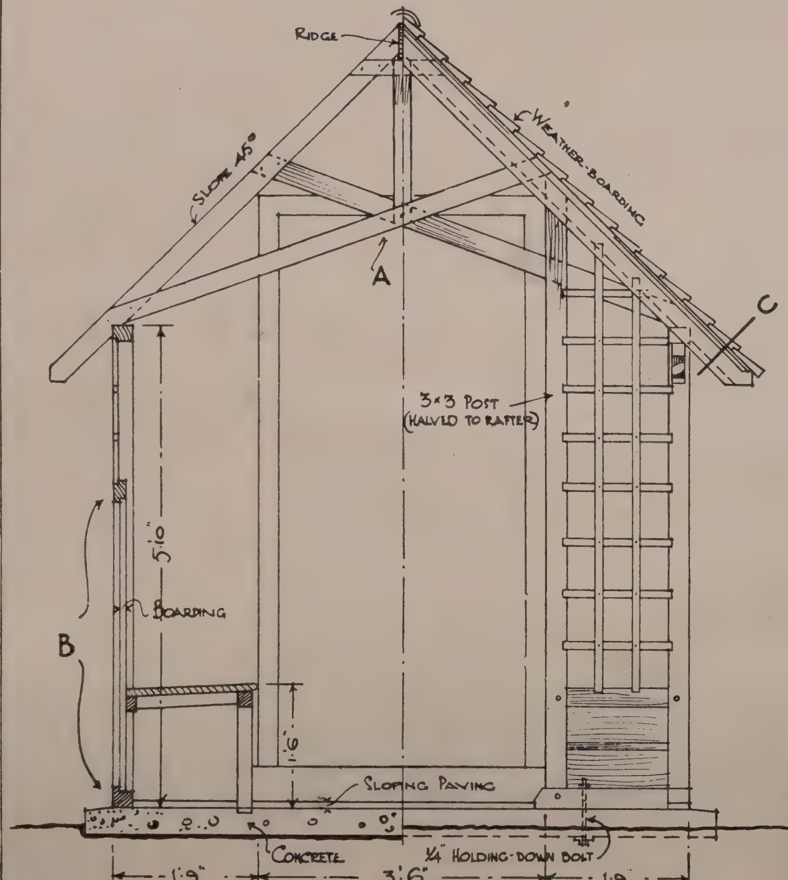


Fig. 40.—Half Section and Half Front Elevation of Trellised Porch

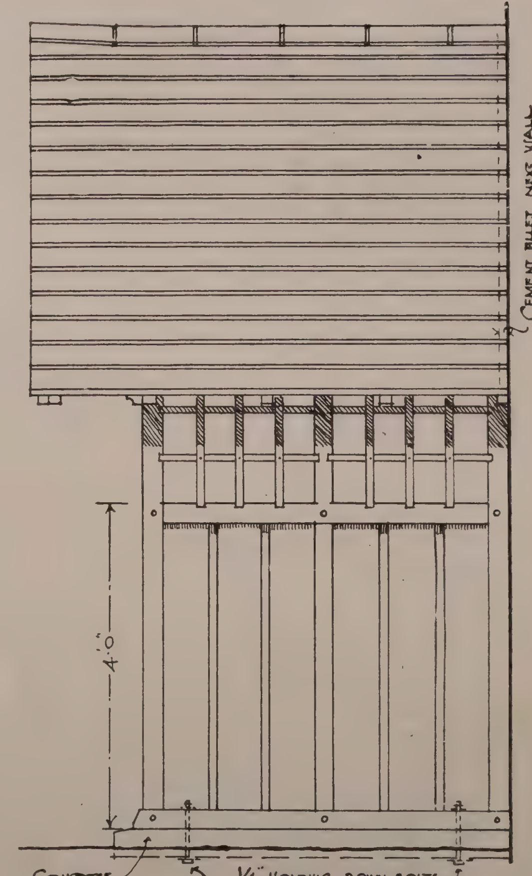


Fig. 41.—Side Elevation of Trellised Porch

Fig. 42.—Half Plans Respectively Below and Above Seat of Trellised Porch

Fig. 43.—Vertical Section through Ridge of Trellised Porch

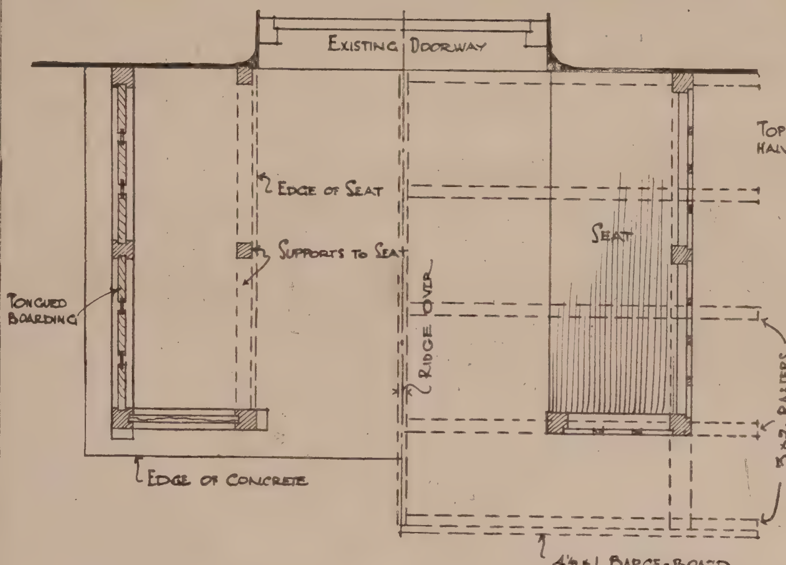


Fig. 42.

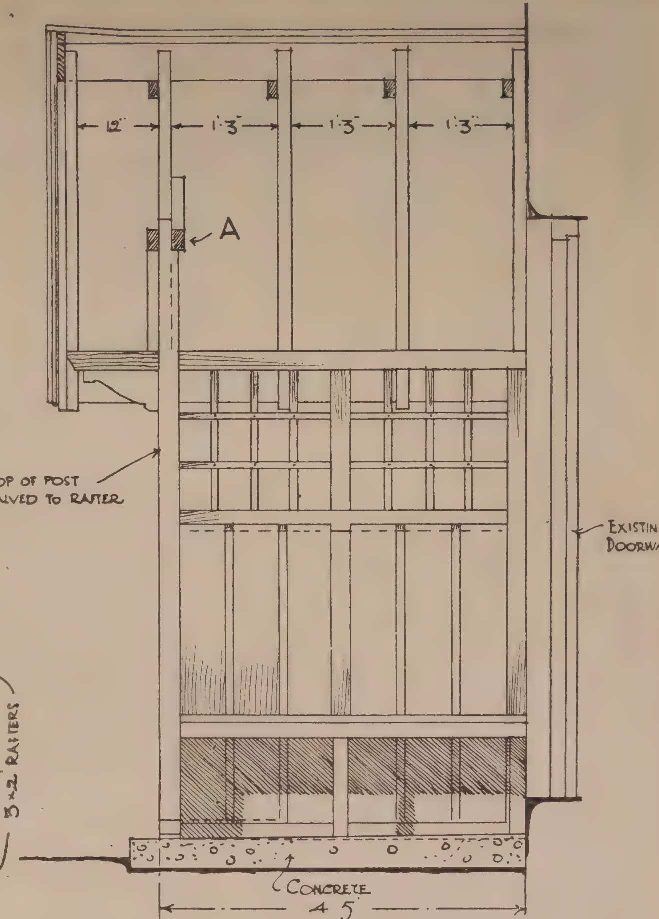


Fig. 43.

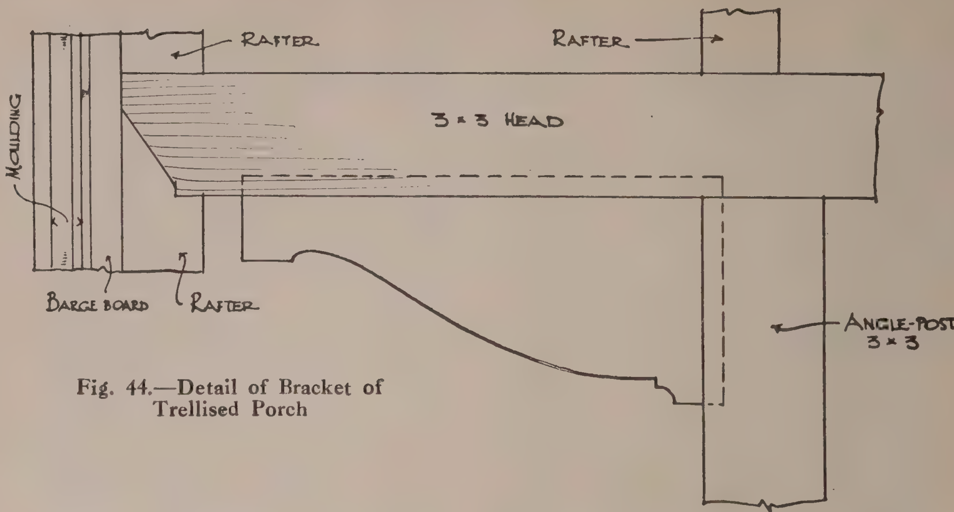


Fig. 44.—Detail of Bracket of Trellised Porch

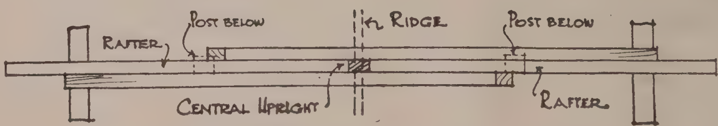


Fig. 45.—Plan showing Trussing to Rafters

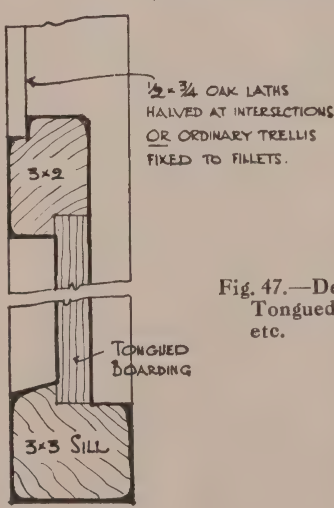


Fig. 47.—Detail of Sill, Tongued Boarding, etc.

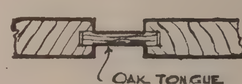


Fig. 46.—Method of Jointing Boarding

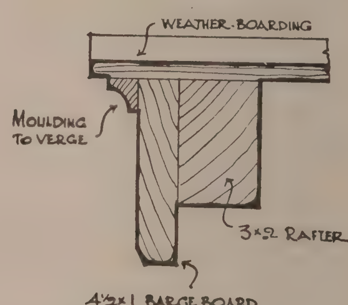
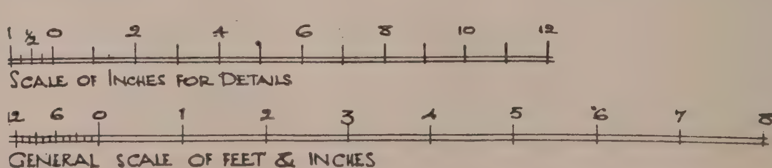


Fig. 48.—Detail of Eaves



larch. The timber of the larch is not subject to knots, as are the other members of the pine family ; but its chief advantage is its non-liability to rot, even in damp places. It frequently happens that the larch poles are erected when in a green state ; and it is then necessary to remember that there is considerable shrinkage in the course of drying.

of perhaps 1 ft. 6 in. The plan (Fig. 51) and perspective sketch (Fig. 49), however, show it to be square, presenting the same general appearance on all four sides.

It can be built up entirely of unwrought larch or similar poles, with small stuff for the filling-in at the sides and in the upper parts. Substantial lengths of a fairly heavy section should be obtained for the

Fig. 49.—Rustic Arch and Espalier

The wood of the larch is yellowish-white in colour, and, whilst generally straight and even, it is frequently coarse in grain and liable to split.

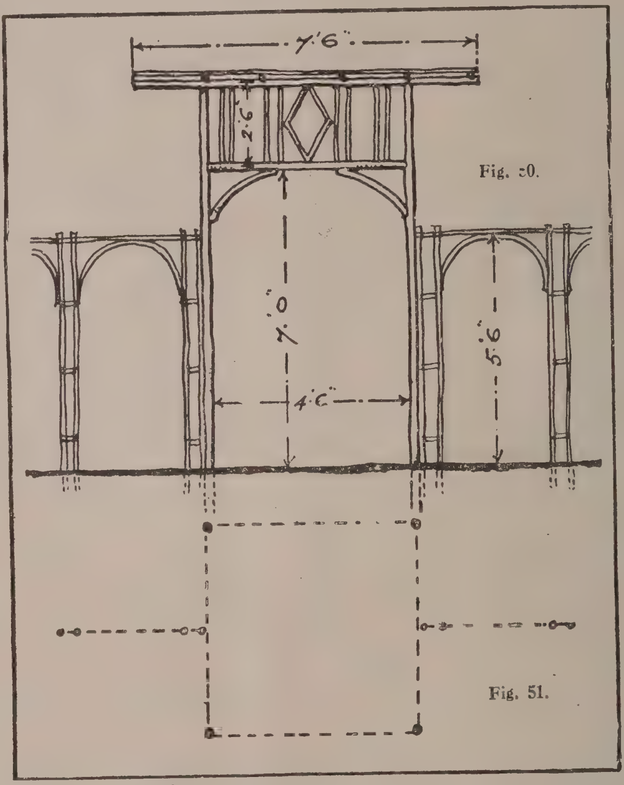
The arch illustrated in Fig. 49 is an elaboration of a type fairly often encountered, as will be seen on reference to the front elevation (Fig. 50), from looking at which it might very easily be taken for a rustic arch of the kind having a depth

main uprights, with their ends well tarred if possible, and bedded, say, 2 ft. in the solid ground. In erecting larch or other posts for arches, screens, etc., one of the best methods is to make a narrow hole with a crowbar, and then drive in the pole by means of blows from a heavy mallet or beetle. By the method of digging holes with a spade for the insertion of the posts the solidity of the earth is destroyed, and

the posts may prove to be loose in their holes. The main horizontal pieces at the top should be lighter, but still fairly solid, the cross-pieces above them being much smaller in section, and the balustrade or railing at the sides might be of similar light material.

The bracket pieces shown across the upper corners on each face should be selected branches of as nearly the required shape as possible, with their ends cut on the splay to suit. Or these can be varied in a number of ways that will readily occur to the worker, who will doubtless also be able to vary the diamond shape and the uprights in pairs shown as filling in at the top of the framework. The whole of the work is intended to be secured together with stout nails driven in on the slant, while for some of the smaller parts, binding round with several strands of copper wire is likely to be found a very efficacious mode of fixing.

The espalier forms a pleasing feature when continued across a garden, lending interest, and dividing it up, but without any appearance of hemming it in. Similar material to that for the arch can be employed, or, if preferred, planed stuff or cane, the latter easily bending to form the semicircular part shown for each bay.



Figs. 50 and 51.—Front Elevation and Plan of Arch and Espalier

RUSTIC SCREENS AND ARCHES

These screens and arches may be varied and modified in a number of ways. The

main framework in each case should be of stout rustic poles strongly nailed together, and let well into the ground to ensure stability; while the filling-in may be of much lighter unwrought branches, etc., or of planed laths or trellis. Such work should be treated with rot-proof stain or coarse varnish.

In Fig. 52 each side of the arch is a square framework or standard, as indicated on the plan, and the sides taper slightly towards the top. These square supports should be repeated at intervals of 5 ft. or so. The second (Fig. 53) is the only design without the supports just mentioned, and will need sloping props on each side of the main posts to withstand wind pressure. Fig. 54 would be suitable for the edge of a terrace or bank.

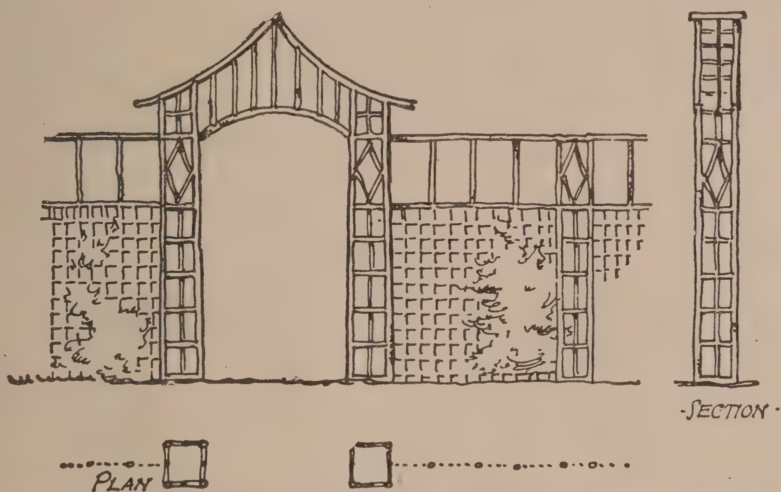


Fig. 52.—Front Elevation, Section and Plan of Rustic Screen and Arch

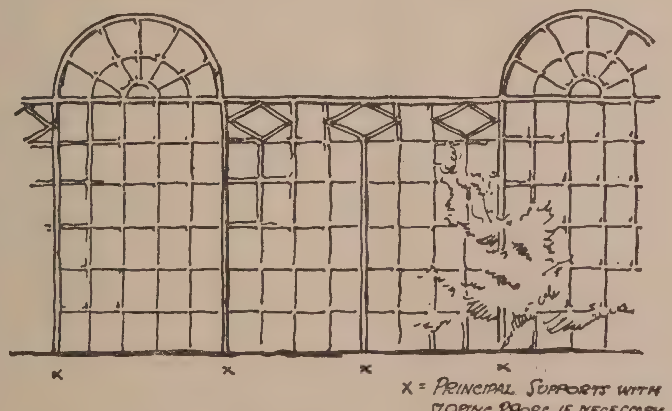


Fig. 53.—Front Elevation of Rustic Screen

Alternative Design.—Another screen illustrated in Fig. 55 is of the very sim-

plest construction, the most primitive material and tools, together with the least possible knowledge of carpentry, constituting all that will be required in order to carry out the design.

Larch poles are very suitable for the main framework and bean-sticks, etc., for the minor parts. The various slightly curved pieces shown should be selected with the outline naturally bent, and ample

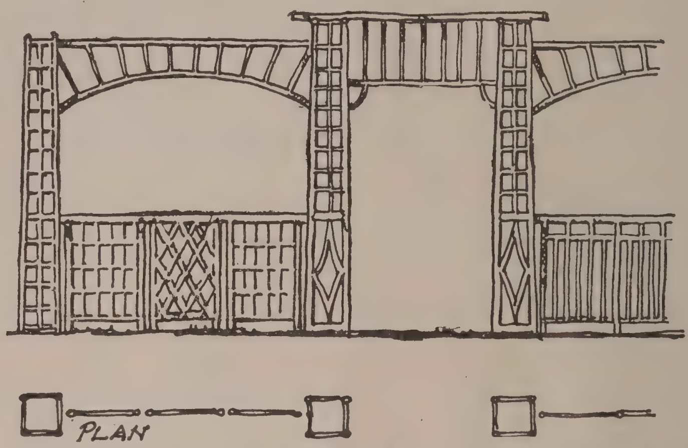


Fig. 54.—Front Elevation and Plan of Another Rustic Screen and Arch

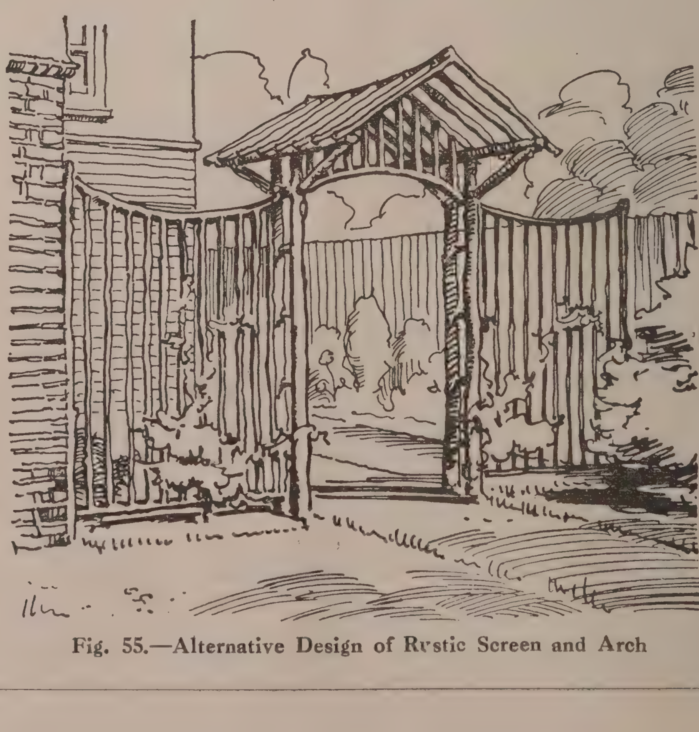


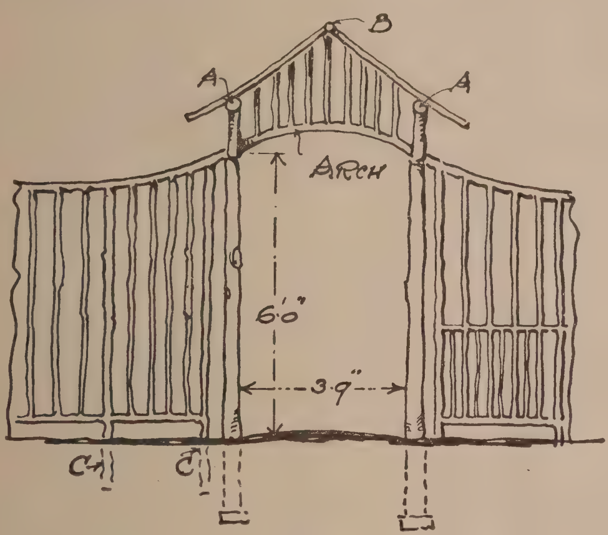
Fig. 55.—Alternative Design of Rvstic Screen and Arch

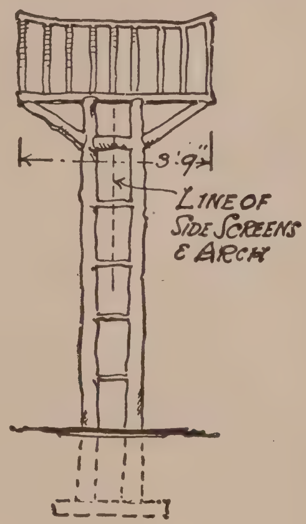
length should be allowed where required for bedding the ends in the ground. In doing this it will be found better to drive the uprights in with a mallet than to dig up the earth; 1 ft. 6 in. or 2 ft. should be plenty for ordinary soils, and if tar is handy an application to the ends intended to be buried will act as a preservative.

It is thought that the construction will be apparent from the illustrations. Briefly, and taking the arch first, this consists of four extra stout uprights standing about 7 ft. 6 in. above the ground, supporting horizontal "plates" (as at A) 3 ft. 9 in. long, having sloping pieces under to form brackets.

The lower ends of the pair of main uprights on each side of the opening should go down about 2 ft., and may be fixed to a horizontal "sole-piece," as shown by dotted lines (Figs. 56 and 57), for additional stability.

A thin piece will need to be used as a ridge (B, Fig. 56), selected if possible with its ends turned upwards as shown in the side view, and connected to the plates by an odd number of pairs of sloping pieces (kept odd in order to have a pair in the centre to take the ends of the small uprights shown above the opening). The sloping members just mentioned should butt against the ridge, and overlap the plate at their lower ends by about 1 ft., being strongly nailed, as, of course, are all the other joints. The actual curved piece for the head of the arch should have fairly stout thickness, and have a series of thin uprights to fill in the space above it.





Figs. 56 and 57.—Front and Side Elevations of Screen and Arch (Fig. 55)

The screens at each side of the arch have naturally curved heads, and main uprights or standards, say, four to each bay, counting the end ones (C, Fig. 56), with short sills fitted in between just above the ground with smaller intermediate poles at the desired spaces; but should these be rather wide apart, or if the passage of animals is to be guarded against, a secondary filling in with thin stuff, as shown to the lower part on the right-hand side of Fig. 56.

RUSTIC PERGOLAS

Many large modern gardens can be more suitably ornamented and beautified by the skilful constructing of a prominent and judiciously arranged "pergola," either along a garden walk or sometimes placed to screen the domestic or vegetable portion of the ground from that devoted to ornamental purposes, namely, flower and lawn surfaces. When erected in an artistic manner and adorned with suitable "climbers," they well repay the amount of labour and cost of erecting same.

In beginning the work, assuming the job worth the extra trouble, construct a couple of portable "saw horses," or instead drive a couple of pieces of larching with pointed ends crosswise into the ground with a "mall" or "beetle," and spike well together where they cross (*see* Fig. 58). For a very large job two or more can be erected midway between the ends of the pergola, and in pairs, say, about 6 ft. or 5 ft. apart, to lay the larching in for cutting same. The "saddles" on the uprights or posts should be cut out as shown in Fig. 59, to hold the runners. Some lay the posts horizontal, as in Fig. 58; others cut them whilst the top end rests in the notch inclining upwards, as in Fig. 60. The latter way is just as convenient, but a little awkward at first to get the bow-saw blade square in the cut. This way allows the knee to be placed on the material. If the stuff is rather green or wet, the blade will require a fair amount of set to get round the curve without sticking or catching in the cut. After the tops are cut, the splices on the runners or plates should be cut to a fixed line marked by means of a cutting box, which is similar to a mitre box, but having a longer bevel cut. It will be found when putting splice end to splice that it (the splice) will require a saw run through the joint to make a neat, clean fit to exclude the rain. Also, it should be a good rule to always mock the splice joints where possible. The rafter pieces can be all nailed on and cut roughly to length, or to a chalk line stretched along the tops.

Premising that the stuff has all been cut within a little, proceed to get the first post into the required or stated height above the ground and well rammed up solid all round. If it is desired to keep the spacing equal all through mark a cord line by winding it round a couple of nails driven in a length of larching the required spacing apart, and marking the cord at the nails with some black paint. Then on stretching the marked line along over the post holes it will give the spacing very easily, and save time as well. To level the posts within a little on a flat location, make a rough plumb rule to hang up in the "saddles" (*see* Fig. 61), and thus

Fig. 58.—Sawing Horse

Fig. 60.—Inclined Post Supported on Horse

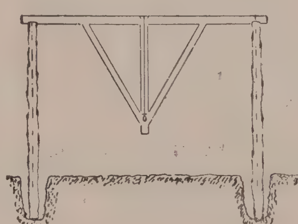


Fig. 61.—Testing Post with Rough Plumb Rule

Fig. 59.—Saddle Cut on Upright to hold Runner

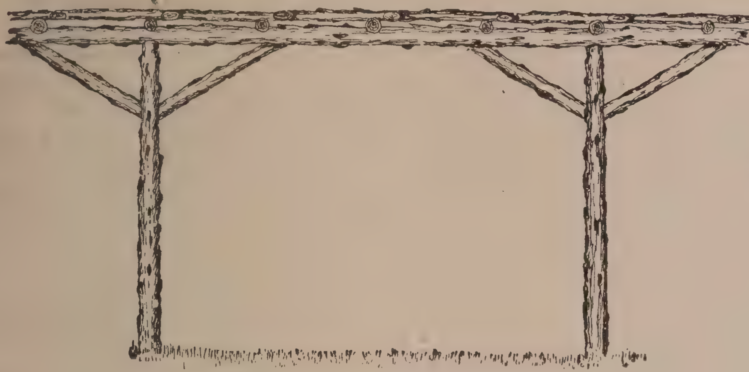


Fig. 62.—Front Elevation of Simple Pergola

Fig. 66.—Elevation of Posts at Corner

Fig. 63.—Plan of Simple Pergola

Fig. 68.

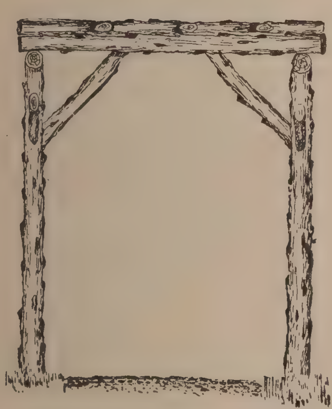


Fig. 64.—End Elevation of Simple Pergola

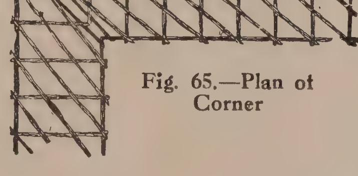


Fig. 65.—Plan of Corner

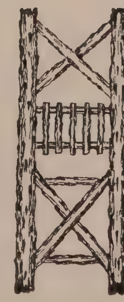


Fig. 69.

Fig. 67.—Plan of Posts at Corner

Figs. 68 and 69.—Fillings between Posts

raise or lower each succeeding post to a nicety. It is a good plan to put a large stone or brick in the hole on which to stand the post if the soil is loose and loamy ; the nailing drives the posts down. The posts, as a rule, can be plumbed up with the eye.

The plates should be nailed between the posts carefully, as the jarring tends to loosen the other parts already nailed. The braces especially require sound nailing, without unduly splitting the stuff, otherwise the structure will weaken from wind causes later on in stormy weather if much exposed. If the pergola has to follow up or down a declivity, the tops will rake the same or follow the ground line, but be level crosswise to the direction or run of same. To prevent winding, it is a good plan to erect and ram up the extreme end posts, and stretch the chalk on same at the top and bottom for the intermediate ones, thus obtaining a good guide with little difficulty. The ramming should be done fairly well above the ground line, so that no water will stand in a pool round the posts.

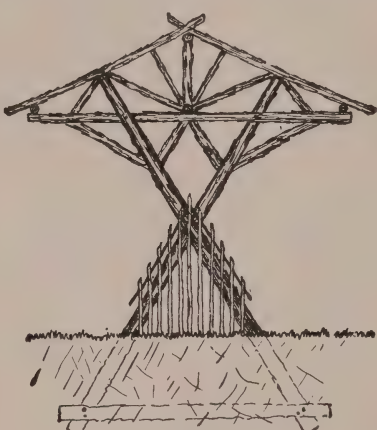


Fig. 70.

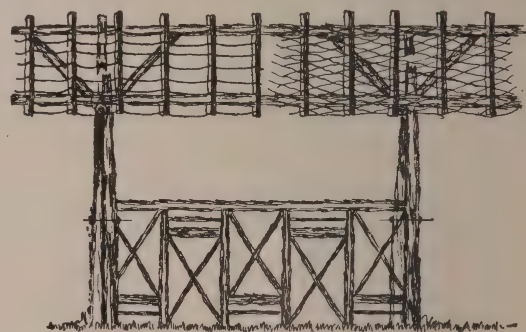


Fig. 71.

Figs. 70 and 71.—End and Side Elevations of Shelter Pergola

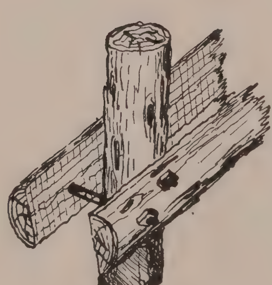


Fig. 73.—Method of Clipping Cross Ties

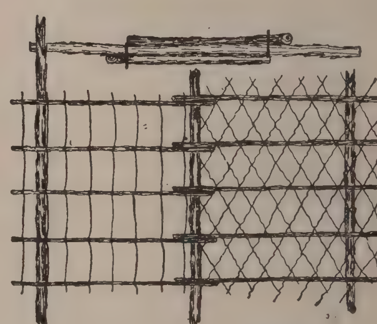


Fig. 72.—Plan of Netting

Figs. 62, 63, and 64 show a simple design for a pergola, presenting no trouble even to the amateur carpenter. Care should be exercised in keeping the diagonal rafters fairly close, so that the " climbers " can run along without requiring a lot of training. In some cases, if the small branches are left on they form an excellent means for enabling this to be obtained.

otherwise long willows can be weaved in and out, just securing the ends with a piece of galvanised wire.

In Fig. 65 will be seen the plan of the pergola showing the manner of working a corner detail. Here double posts should be arranged (*see* Figs. 66 and 67); the diagonal runners meet and hang over the mitre corner, whilst the cross bearers mitre together, and lay on two inserted carrying diagonal bearers. This arrangement lends itself to great variation, and the diagonal bearers could also be made flush with the runners. These methods will equally apply to any angular corner other than square. Curved braces can be cut if obtained, and fixed here and missed to allow of passing from side to side. Fig. 72 is a plan of the netting, either diagonal or rectangular mesh, laid over roof spars for the foliage of the "climbers." The detail (Fig. 73) shows how the standards are clipped between the earth-buried cross ties, and bolted up with galvanised bolts and nuts or otherwise spiked on with galvanised French or rose-headed gate nails.

An alternate design is given in Fig. 74, whilst Fig. 75 shows a different filling for the panel. These should not be always slavishly copied, but should serve as examples to be thoughtfully improved on, and serve as guides to sound construction. Rough tenons and mortises will considerably strengthen any intricate detail of filling. The type shown in Fig. 70 could be easily made into a square-form shelter, by having another crossing set of tied standards at right angles. The vertical lower cross filling would in this case be omitted, and the roof made out from a central spar, bored at the top end to receive a small flag-pole.

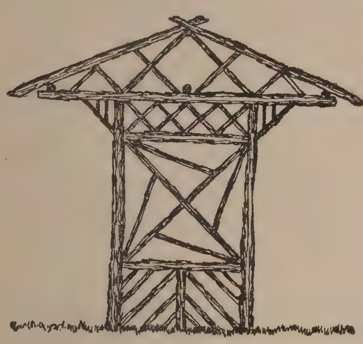


Fig. 74.—Alternative Design of Pergola

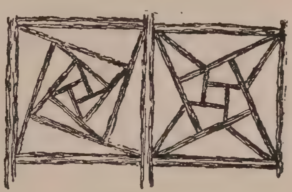


Fig. 75.—Filling of Panel

there in pairs, whilst in Figs. 68 and 69 are shown alternative filling in between the posts.

More Simple Designs.—A simple form of pergola that differs from the previous one is shown in Figs. 70 and 71, and forms, more or less, a charming shelter which could be easily made rainproof by waterproof cloths or coverings, or else close-laid boarding with water grooves in same. Thus their erection is more suitable to public gardens, pleasure grounds, and similar places. It will be seen in Fig. 70, which is an end elevation, that the roof is umbrella-shape in section, whilst in Fig. 71, which is a front elevation, the filling in between the cross standards is clearly shown, and can be in alternate bays, or two or more bays filled, and then one

Single Pole Type.—In the front elevational view (Fig. 76) is shown a shelter of the single-pole or standard type. This would act as a divisional screen or fence, and a sunshade when placed in a position facing north. It is simply constructed, and should be strong and substantial to avoid undue pressure from wind force acting on the top portion, with a consequent leverage due to the height. Fig. 77

is a side view, whilst Figs. 78 and 79 show alternate methods of laying the roof spars, either splicing same, or else running the ends by taking care that the joints "mock" or otherwise do not come all on one inclined supporting spar.

The standards are firmly braced and tenoned into sole-plates (Fig. 80), which are placed in rectangular trenches with a well-rammed bottom, fairly level to maintain a plumb position of the standards, whilst the re-turned soil is being rammed round same. The horizontal runners are cut right between the posts or standards, and are held in place with dowels, as in Figs. 81 and 82. It will be clearly seen that to get the dowel pins in correctly, a beginning must be made at one end as follows: Support the first bay runners in position, and then bore from the opposite sides of the standards into the runners. Then remove these, and place No. 2 bay runners in correct position, bore into same through the already bored holes in the standard next to No. 1, and then right through the other standard into the farther or opposite end. Next take these away, place No. 1 bay runners with the sawn joints creosoted in the final position, and drive dowels into same until they project about 2 in. or 3 in. out of the standard. Then the runners of No, 2 bay

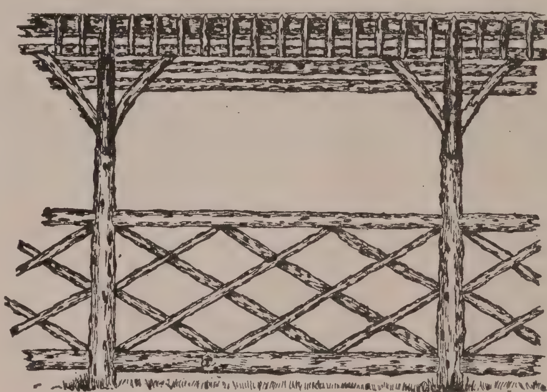


Fig. 76.

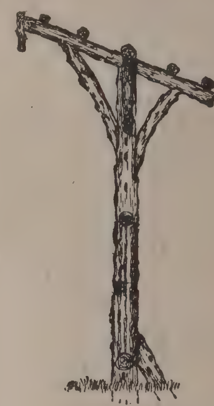


Fig. 77.

Figs. 76 and 77.—Front and End Elevations of Single-pole Pergola

Fig. 78.

Fig. 79.

Figs. 78 and 79.—Two Methods of Laying Root Spars

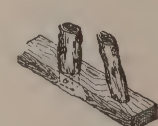


Fig. 80.—Standards Fixed in Sole-plate

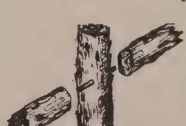


Fig. 81.

Fig. 82.

Figs. 81 and 82.—Method of Dowelling Runners into Posts

are knocked on the projecting dowel ends, the other end driven down into place, and so on. Otherwise, to facilitate or expedite the work where possible, the centre bay can be done first, then working away from same to each end.

Along the front edge of the top a horizontal spar is well spiked or nailed to the inclined top bracing spar, and along on this front short pieces are nailed as shown, to form a bordering or fascia. It should be noticed how securely braced this design is, and should be soundly constructed and strongly nailed. The dowel method is shown here in preference to mortise and tenon, as these would unduly weaken the standards.

Fig. 83.—Front Elevation of Open Side Pergola

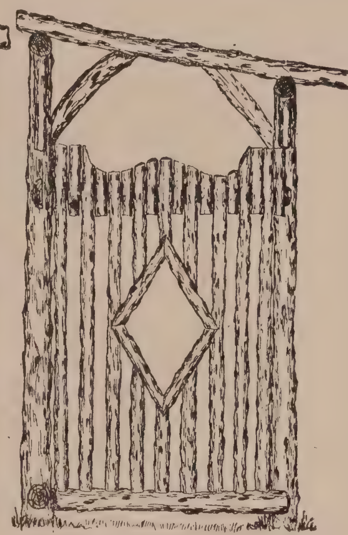


Fig. 84.—Side Elevation of Closed Side Pergola

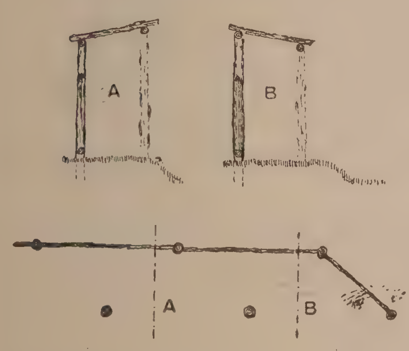


Fig. 85.—Two Elevations of Frames and Plan of Promenade Pergola

Promenade Pergolas.—The pergolas shown by Figs. 83 and 84 are of the open and screened side type, forming pleasant promenades and seat walks, and are more elaborate than the ordinary post and rafter type. In Fig. 85 is shown a plan of the two types, and a side view of each (A and B), the difference only consisting in the rake of the roof spars. Observe that the posts or standards are not in front of one another on a transverse plane, but zigzag in plan (*see* Fig. 85), one plan serving for both side views.

The filling in of the screened sides may be split fence larching, which is usually sawn down the centre. They are nailed to sawn top rails, which are tenoned into the posts and pinned. The over-lapping top and bottoms of the profile pieces or short pales are secured at the back by nailing on galvanised hoop iron, with holes

punched in same to receive the nails. They are usually cut to shape by nailing them on temporarily, and then marking them by chalking round a template placed correctly over the ends. It should be observed that the pales stand on a runner rail at the bottom, which clears the ground to prevent rot or decay.

In Fig. 86 is shown a pergola that possesses a feature of relieving the ordinary type by altering the outline of the roof spars on each side, by alternating the position of same, and giving at the same time twisting surfaces to the planes of the roof spars, which are clearly shown in Fig. 87 (side view) and the plan (Fig. 88). The

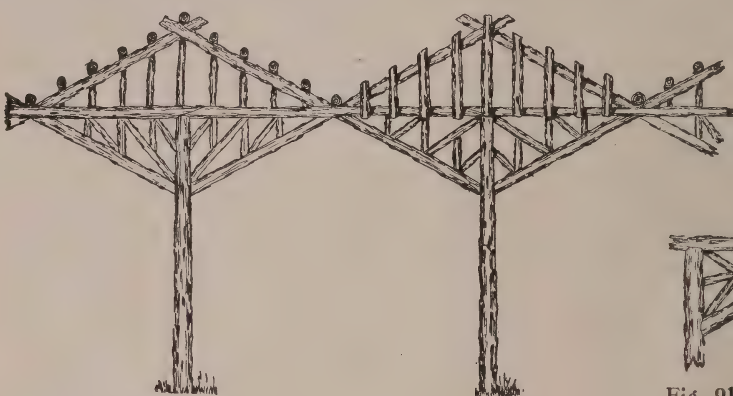


Fig. 86.—Alternative Design of Promenade Pergola with Alternated Roof

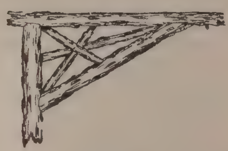


Fig. 91.—Brace Filling

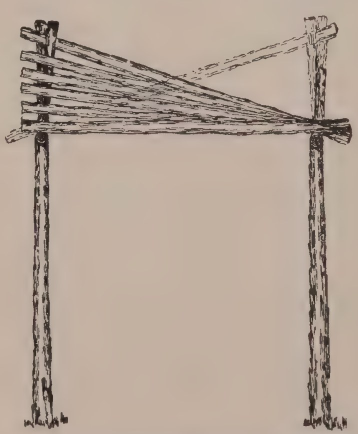


Fig. 87.—Side Elevation of Pergola with Alternated Roof

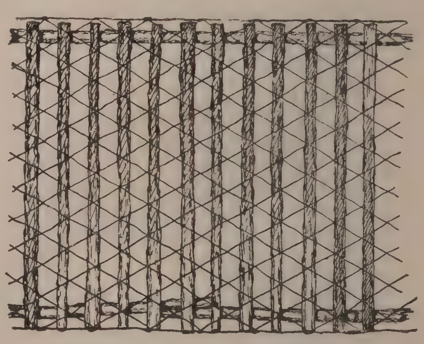


Fig. 88.—Plan of Pergola Roof

Fig. 90.—Detail, showing Position of Post Bolts

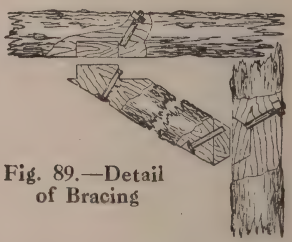


Fig. 89.—Detail of Bracing

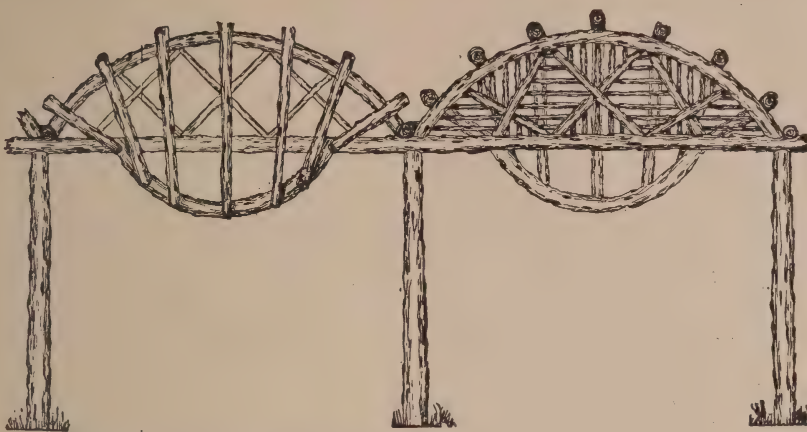


Fig. 92.—Design of Pergola with Alternating Segmental Roof Spar

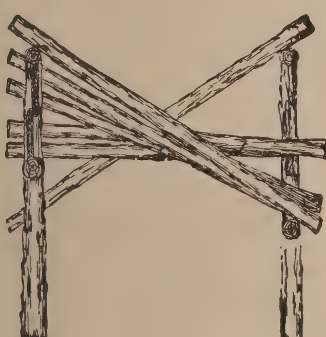


Fig. 93.—Showing Winding of Roof Spars

Fig. 95.—Detail of Joint of Curved and Horizontal Pieces

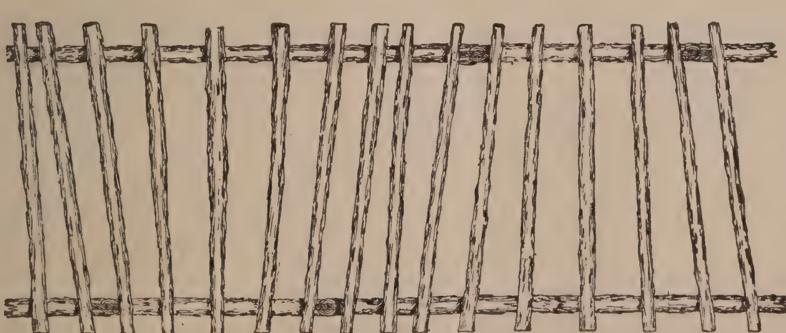


Fig. 94.—Plan of Roof

spars are approximately parallel to one another ; but as will be seen, they lay up on the gable spars, the centre one resting in the cross intersection at the top. This arrangement occurs on each side alternatively, and will produce a novel and pleasing effect. The detail (Fig. 89) shows the bracing secured with mortised-and-tenoned joints bolted up, whilst Fig. 90 shows how the post bolts must pass one another for clearance purposes where two braces occur. Fig. 91 is a detail of brace filling.

The design shown by Fig. 92 gives variety by alternating the segmental roof spar with a reverse curve dip on the other side, thus producing a pleasing outline. Fig. 93 shows quite clearly how the roof spars wind, and the plan (Fig. 94) shows also how they radiate on each side to a centre point caused by the reverse curved plate or runner spar. A detail of the joint is shown by Fig. 95. The wrought iron strap should be well screwed at the joint, whilst the dowel pins will prevent sag. Careful bracing underneath the roof spars, with an angle iron here and there, will thoroughly tie the sides together.

Summerhouses

OPEN-FRONTED SUMMERHOUSE

A SUMMERHOUSE of modern design, which will be found to entail practically no complicated work in its erection, providing that the directions given are carried out, does remarkably primitive ideas, and being quite at variance with modern ideas. Rustic (that is, unworked) material is well enough in its place, and is permissible for arches and similar erections; but for larger work it has little to com-

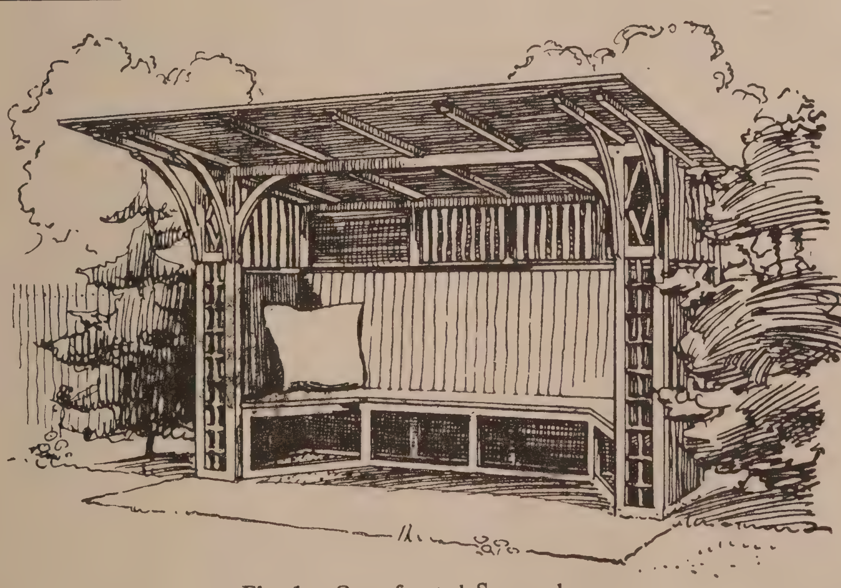


Fig. 1.—Open-fronted Summerhouse

is shown by the sketch Fig 1. Its design is in opposition to the so-called "rustic" type of work which would seem to have been rather overdone, exhibiting as it mend it. In such cases, the main framework should be of properly wrought stuff, while any filling-in and minor details generally may properly be carried out

with lengths of branches, if desired, as is suggested in the present instance.

Front and end elevations, cross section and plan are given by Figs. 2, 3, 4, and 5.

Briefly describing the summerhouse in detail, the plan shows the assumed dimensions, which are liable to be varied in order to meet particular requirements, always endeavouring, however, to preserve as low and wide an effect as possible, for which purpose the opening on the front is kept down to 6 ft. high as the absolute minimum. The work will most probably be secured in position by bedding the ends of the upright members in the earth, either tarred or bedded in concrete. An alternative method would be to screw the framework (without any projecting ends at the bottom) firmly to suitable wood fixing-blocks, bedded in a layer of concrete over the whole area involved.

Referring to the sketch of the construction (Fig. 6), this shows in perspective the main framing of one-half of the summerhouse, and this would make a substantial job in 2-in. by 2-in. stuff, or a little smaller section could be used. The main uprights consist of A and B about 8 in. apart in front, and C at the back corner, these being all bedded in the ground if this method is adopted. Between them, and of such lengths as to keep them at the correct distances to make up the dimensions given, are sill-pieces D, E, and F, tenoned

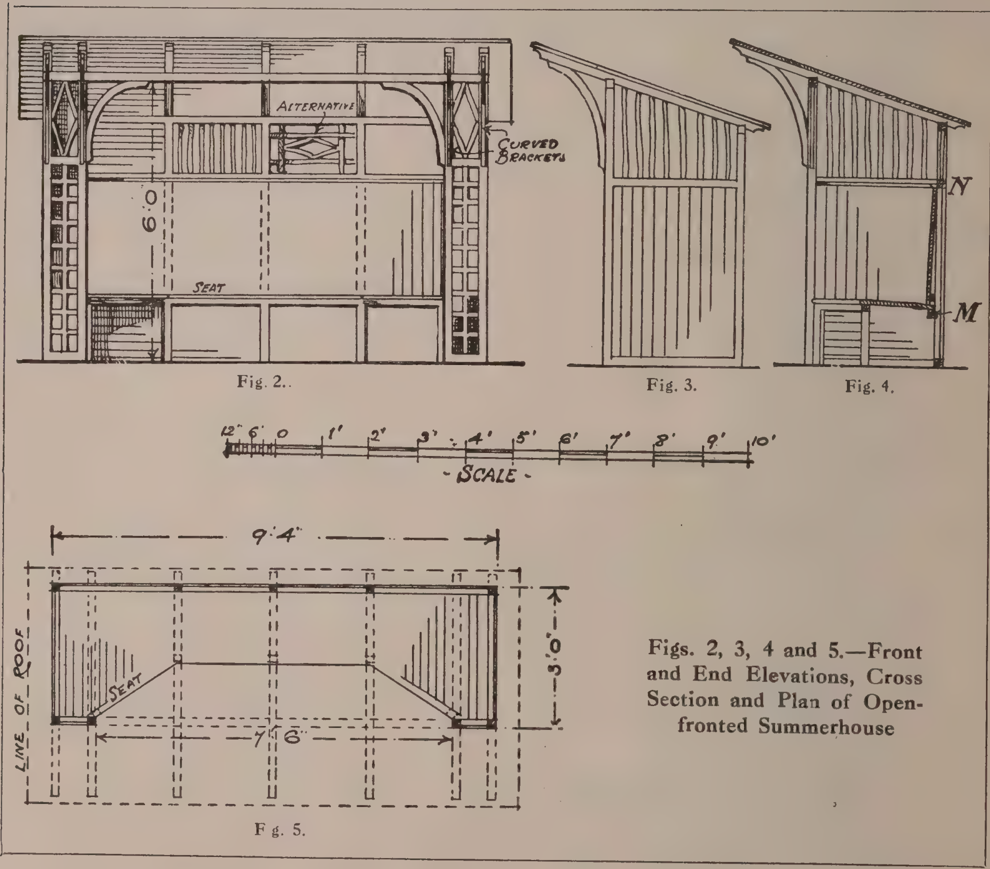


Fig. 2. Fig. 3. Fig. 4. Fig. 5.

Figs. 2, 3, 4 and 5.—Front and End Elevations, Cross Section and Plan of Open-fronted Summerhouse

into the uprights. (Notice that F runs the whole length of the back.) Heads G and H are fitted along the front and back, jointed to the uprights, as shown on the enlarged details (Fig. 7) and three intermediate uprights, two of which show at J and K, are fitted between the back head and sill. Notice that these do not divide the whole width of the back height of about 4 ft., to take the boarded back to the seat, the short length in front between A and B being kept a little higher to reduce the length of the top panel thus formed.

The sloping rafters, with shaped or plain ends projecting 2 ft. or more in front and 6 in. behind, are set out directly over the uprights as shown, to receive a

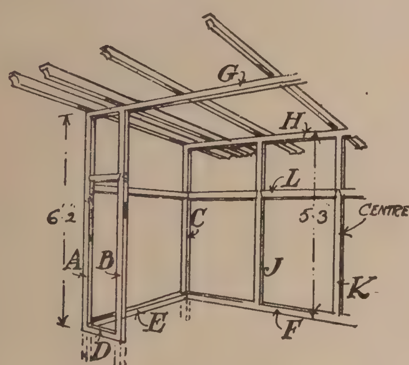


Fig. 6.—Construction of Frame of Open-fronted Summerhouse

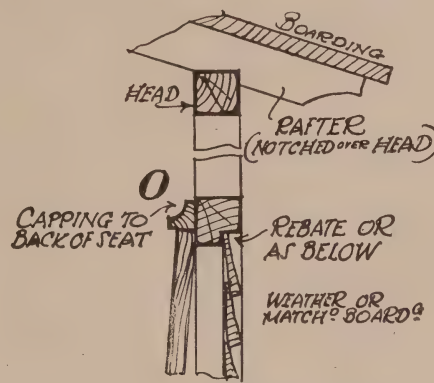


Fig. 9.—Constructional Details of Finishings

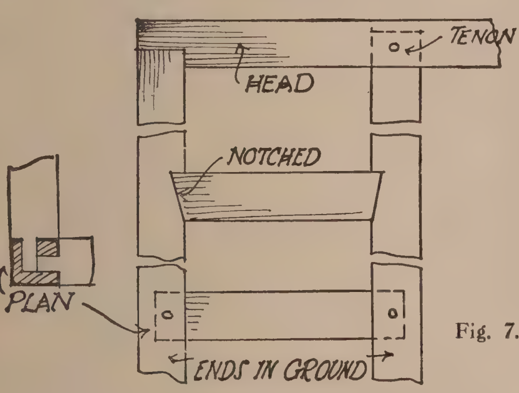


Fig. 8.—Showing Strip Planted on to Form Rebate

Fig. 7.—Details of Framing of Summerhouse

into four equal parts, being set out to equally quarter up the space between B and its counterpart on the other side (marked 7 ft. 6 in. on the plan), the reason for doing which will be apparent when the roof is dealt with. Intermediate horizontal rails, as at L, are notched between the uprights, in the manner indicated in the enlarged details, at a boarded and felted or some similar roof. They should be notched to fit over the heads; or for a simpler method the upper faces of the latter may be splayed off to the required angle, and the rafters then firmly spiked on without any other connection.

Thus far advanced the skeleton should be quite rigid; but if leaving anything

to be desired, diagonal braces might be fitted across the openings of the lower part to stiffen the whole.

As regards the finishings. the outside can readily be covered in where shown with matchboarding or feather-edged weather-boarding fixed on the face of the work, or into rebates, previously worked to receive it. (Both this method, and an alternative in which a small strip is planted on to form a rebate, are shown on the enlarged details, Figs. 8 and 9.) The open panels can be filled in with laths or rough branches in the diamond or lattice forms shown. The six curved brackets should be at least 1 in. thick, cut to good continuous curves and strongly secured. They will complete the work except the seat, on which a certain amount of care should be expended if the whole is to be a success. for unless it is thoroughly comfortable this result cannot be attained. Uprights will be required along the front, either with or without a sill next to the ground, and support horizontal bearers, another being fixed across the uprights at the back (*see* M on cross section), slightly lower than the front, which might suitably be 1 ft. 4 in. high, so as to obtain a slope. Light strips having their upper angles rounded off and of sufficient strength to span the increased distance at each end where the seat widens, are fixed across at close intervals, and should stop short of the front edge of the front bearer, and be finished with a rounded nosing fixed on top of the latter and projecting slightly.

The back of the seat is formed of matchboarding nailed to a small fillet just above M, and to the intermediate rail at N (*see* cross section), with a small moulding as a capping as shown at O on the enlarged details. To keep the work simple it will be quite satisfactory to make the seat backs at the ends vertical instead of sloping.

It is probably superfluous to urge in conclusion the necessity for properly painting or otherwise preserving the structure. Any preservtive will suit.

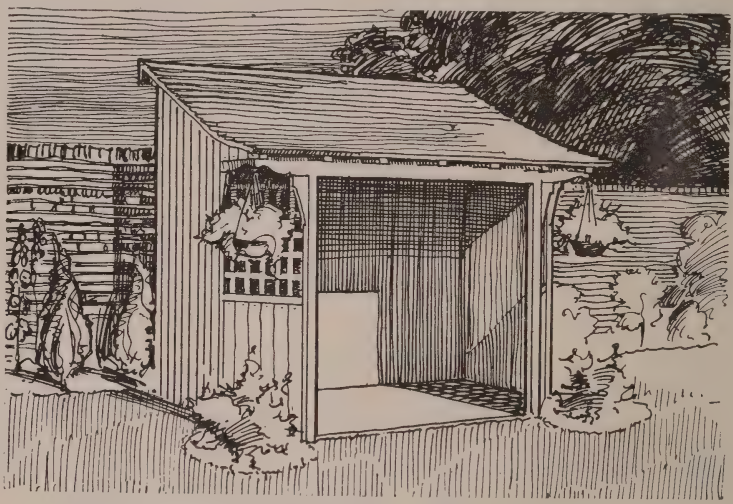


Fig. 10.—Another Open-fronted Summerhouse

ANOTHER OPEN-FRONTED SUMMERHOUSE

To the average worker the summerhouse shown by the perspective sketch (Fig. 10) and by the drawings Figs. 11 to 14 should present but few difficulties, all these having been as completely as possible eliminated in the planning. It is quite unpretentious, deriving its effect from the treatment of the sloping angles, over which the roof projects, thereby forming suitable positions for hanging baskets as shown, the whole having a certain character never to be attained

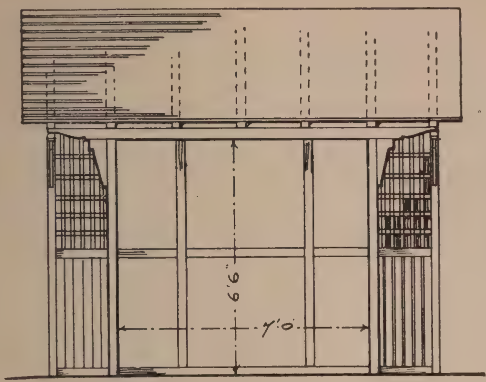


Fig. 11.

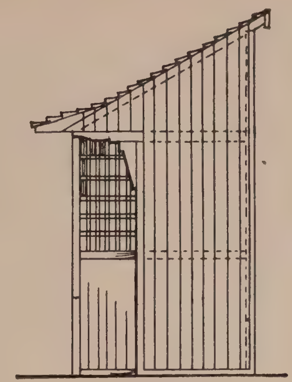


Fig. 12.

Figs. 11 and 12.—Front and End Elevations of Summerhouse

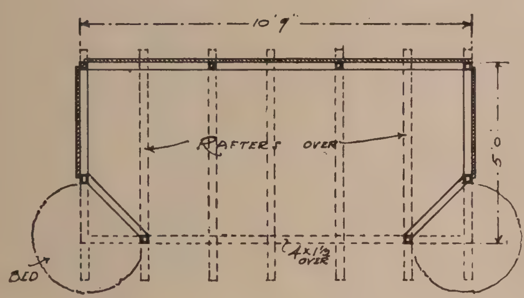


Fig. 13.

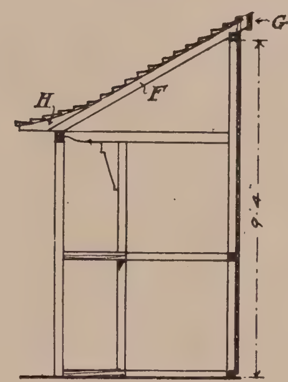


Fig. 14.

Figs. 13 and 14.—Plan and Cross Section of Summerhouse

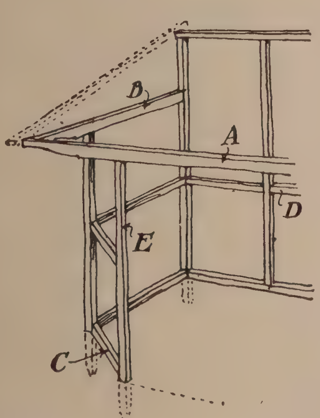


Fig. 15.—Showing Construction of Framework

Fig. 16.—Enlarged Details of Ends of Head Pieces and Brackets

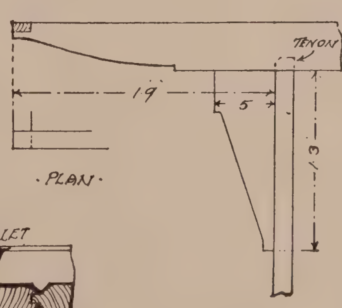


Fig. 17.—Enlarged Detail showing Method of Fixing Matchboarding for Sides

Scale for Figs. 11, 12, 13 and 14

by summerhouses of the usual "rustic" variety.

The principle of the work is explained by Fig. 15, a rough diagram of one-half of the framework, all the parts being of stuff about $1\frac{1}{2}$ in. square, with the exception of the heads A and B, which might with advantage be $3\frac{1}{2}$ in. or 4 in. deep. It is all fixed together and made up in accordance with the dimensions given, or to suit any special requirements. The main uprights have for preference tarred and spiked ends bedded in the ground, unless there is any likelihood of removal, in which case the sills might be anchored down to pegs driven into the ground. Should a boarded floor be wanted, it can be contrived to rest with the necessary bearers or joists on the sills, the total height of the structure being increased accordingly.

All the angle-posts should be tenoned into the heads, and the ends of the sills similarly fitted into the angle-posts, although an exception might be made in the case of the sill across the angle at C, this being merely butted and strongly nailed in place, the intermediate uprights at the back and the middle horizontal rail D receiving similar treatment. The ends of the head A overhang the front posts E for 1 ft. 9 in., as does also the end of the part B the post below it. These parts A and B are halved together at their extreme ends, shaped to the given curve, and finished with brackets 1 in. thick below, all according to the enlarged detail in Fig. 16.

Rafters as at F (Fig. 14) are spaced out equally, spanning the width between the front and back heads, splayed off at their feet, and notched to fit over the back, unless it is preferred to slope the top of this portion to the same angle as the whole roof, and then simply nail the rafters on it, in either case letting them project about 4 in. and finishing with a small fascia board as G. To get a good effect, the feet of the rafters should have "sprockets" (that is, pieces shaped as at H to lessen the slope of the roof next the eaves) fixed on top, and arranged to project horizontally about 1 ft., the curved line thus imparted to the roof greatly improving its general appearance.

The roof can be covered with any of the usual materials, preferably feather-edged weather-boarding, while the same covering or matched and V-jointed boarding, fixed vertically, can be used for the sides and back, either fixed on the face of the framing, or, for a good-class finish, fixed on small fillets planted round, as at J in Fig. 17. The latticed parts at the sides can be easily built up of laths regularly spaced out, and, of course, the entire work will need thorough treatment with paint, etc., to ward off rot and decay.

With regard to the position of this summerhouse and the treatment of the surrounding garden, it is difficult to write anything of general application; but the small circular beds shown at the corners might be worth considering, while, if at the end of a plot, the little building might serve as a screen for a frame-ground, or for the various garden impedimenta of a more or less undesirable appearance. It might very easily be extended during the months of summer and autumn by means of a canvas awning hooked to the head A (Fig. 15), and carried to suitable upright poles with any guy ropes found to be necessary. Apart from this idea, and without affecting it either way, should it be thought desirable to enclose the summerhouse, a pair of suitable doors could be formed of rectangular trellis on light wooden frames. Any fixed seating in the interior can very easily be arranged for.

GABLE-FRONTED SUMMERHOUSE OR SHELTER

Another example of a summerhouse of a better style than can be produced by the use of the ordinary "rustic" material is shown by Fig. 18. Though this is composed entirely of worked stuff, endeavour has been made throughout to scheme it in such a way that only the minimum amount of labour will be involved, consistent with a presentable appearance. The design has been kept

free from the fussiness and attempts at ornament so often encountered, the effect aimed at being that of a substantial and durable shelter. To this end the framing of the front portion more especially should be made of as heavy material as is reasonably possible, although for actual considerations of strength much lighter posts, etc., than those advocated could be made to serve the purpose equally well. With care it will be understood that some of the tenons, etc., often employed in such a case could be omitted ; but anyone at all conversant with the use of carpenter's tools will be in a position to settle these points of procedure to suit his own views. A front elevation section and plan are shown by Figs. 19, 20, and 21.

The base of the summerhouse consists of a rectangular frame of sill-pieces as outlined by A, B, C, and D (Fig. 21), say $3\frac{1}{2}$ in. wide and 2 in. high, halved together at the four angles. This frame can be well tarred and bedded in earth or gravel, or spiked firmly down to suitable wooden blocks embedded in a layer of concrete spread over the site. Later, when the structure has been completed, the space inside the frame can be filled in with either concrete finished cement-face, gravel or other paving, or a boarded wood floor can be laid across it from one side to the other, all necessary intermediate sleepers or plates to support it in the centre being supplied as found to be required.

Fig. 18.—Gable-fronted Summerhouse or Shelter

Upright square posts $3\frac{1}{2}$ in. by $3\frac{1}{2}$ in., as at D and C (Fig. 21), are prepared and stub-tenoned into the angles of the sill, as shown in detail by Fig. 22. They will be about 4 ft. 9 in. high from the top of the sill, and if preferred could be of $3\frac{1}{2}$-in. by 2-in. stuff with the greater width

towards the front, a remark equally applicable to posts E and F (Fig. 21). These latter have their feet tenoned into the front sill, and will be about 6 ft. long. At their heads they are tenoned into a horizontal piece G (Fig. 19) of the same thickness and measuring about 4 in. on the face. This in turn should have splayed ends tenoned into rafters, as at H and J in the same figure, although, as a matter of fact, a small piece of iron as a strap screwed across the joint on the inner face makes a passable substitute. This method of jointing is also suitable for the junction of the two rafters at the apex of the front gable, no ridge-board being required in such a case as the present. The lower ends of the rafters will simply be cut to the required angle and firmly spiked down to the top of the corner posts, and their upper faces bent out to a flatter slope by means of triangular "sprockets," as at K (Fig. 19), projecting about 9 in. beyond the sides. The four upright members in the gable-end can be prepared from boards of about 4 in. by $1\frac{1}{4}$ in. or 1 in., spaced out at equal intervals and having their ends merely butted into position. The two curved brackets, cut out of pieces 12 in. by 4 in.

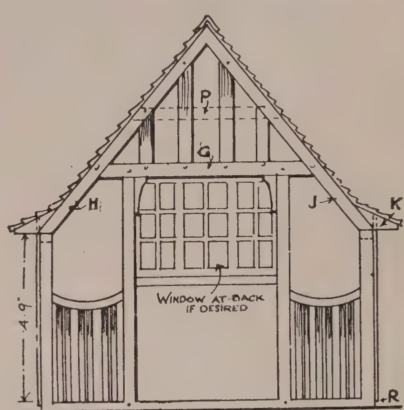


Fig. 19.

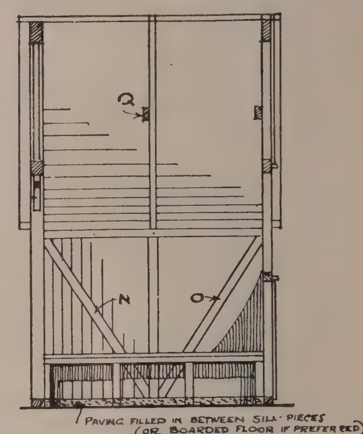


Fig. 20.

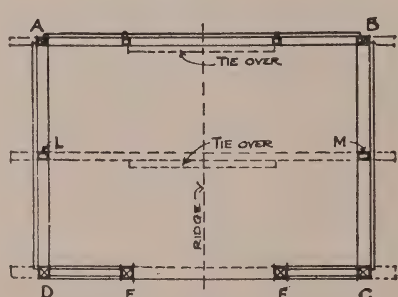


Fig 21.

Scale for Figs. 19, 20 and 21

Figs. 19, 20 and 21.—Front Elevation, Section and Plan of Gable-fronted Summer-house or Garden Shelter

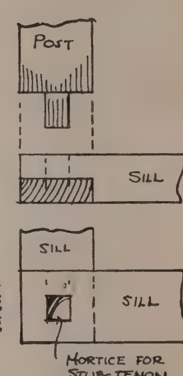


Fig. 22.—Elevation and Plan showing Method of Fixing Post to Sill

by, say, $1\frac{1}{2}$ in. thick, can be planted on without jointing, and the plain square handrail weathered on top and either straight or slightly curved as shown, together with the plain square balusters under set out in pairs, can all be fixed simply with butted and nailed ends.

The framing of the other parts of the summerhouse is quite rudimentary, and can be composed of rather lighter stuff if desired. For each side is required a back post, as at A or B (Fig. 21), fixed as in Fig. 22 to the angle of the sill, an intermediate upright L or M (Fig. 21), and a head fixed between the angle-posts. The back will be formed in much the same way, with two intermediate uprights taken up to meet the rafters, which are similar to the front ones but rather lighter. A couple of horizontal rails will be required if it be decided to introduce a window as shown, which can be glazed or of the trellis variety.

Should any part of the structure appear at all lacking in steadiness at this stage (as there is always a tendency for rectangular framing without diagonals to do), it should be stiffened with braces fixed across the spaces in the framework, as at N and O (Fig. 20). Two rafters will be needed in the centre over the two intermediate uprights in the sides, butted together at the ridge and stiffened with a "collar" spiked on, as at P (Fig. 19) and Q (Fig. 20), suitable also for the back rafters.

The roof can be covered with weather-boarding or plain boarding to take felt or Willesden paper. The sides and back can also be filled in with weather-boarding, or matched and V-jointed boarding, with its edges vertical, care being taken to keep this clear of the ground as far as possible (R, Fig. 19), and fitting it close up to the underside of the roof-boarding as indicated at K (Fig. 19). The boarding

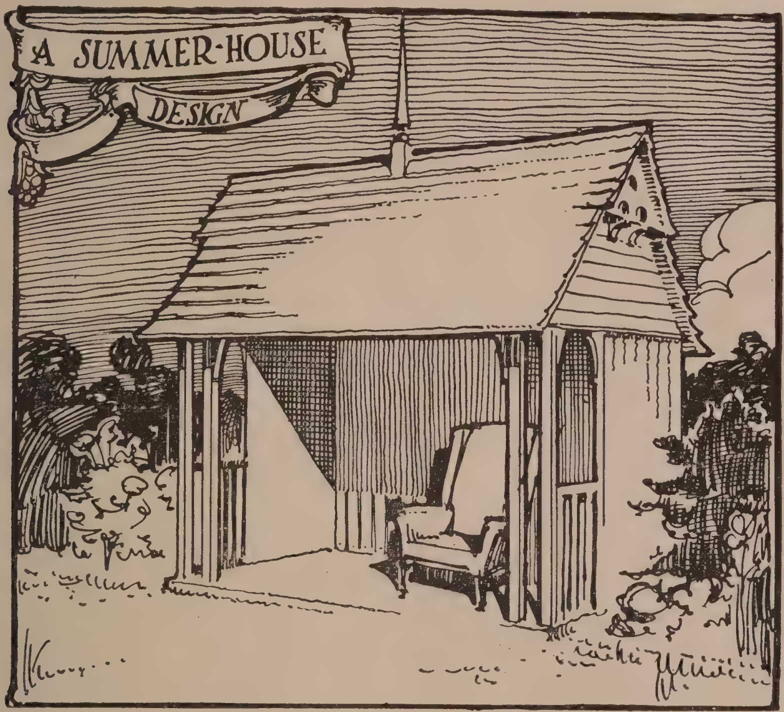


Fig. 23.—Gable-roof Summerhouse with Pigeon Cote

round the window at the back will require to be finished with a bead or moulding, and a number of projecting pegs, either constructional or mere shams, on the front will tend to add interest to the general effect, and are indicated in Fig. 19.

The interior can be lined with thin matchboarding if desired, and seats fitted where required.

GABLE-ROOF SUMMERHOUSE WITH PIGEON COTE

The claims to originality in the design of the summerhouse shown by Fig. 23 are based in the main on little differences in the detail of the finishings.

Front and end elevations, cross section and plan are shown by Figs. 24 to 27.

Broadly, there are two ways in which it is possible to set about the erection of such a house, one being to leave projecting ends on the main uprights, and bed them solidly in the ground, the horizontal rails being previously framed into them; and the other, and generally preferable method, consists of the use of a set of sill-pieces of a substantial size, halved at the angles, and having the uprights stub-tenoned into them, as shown in Fig. 28. With this latter system it is usually essential to spike the sill-pieces down to stout wooden pegs buried firmly in the ground.

Assuming the house to be built in this latter way, the main framework might well be as shown in Fig. 29, the various dimensions being as figured on the other illustrations, or adjusted to meet special requirements. In the figure are shown 3-in. by 3-in. sill-pieces, and 2-in. by 2-in. uprights, one at each corner, stub-tenoned at the bottom into the sills and at the top into 3-in. by 2-in. heads set with their 3-in. sides upright and about 10 ft. long, as at A and B. Shorter heads measuring about 2 in. by 2 in. are filled in at the ends, as at C and D, without tenoning. Two pairs of rafters, 2 in. by 2 in. or any other convenient size, are then prepared to slope rather more than 45°, notched to fit over the heads and cut to a splay at their tops to fit against a ridge piece about 4 in. by 1 in. and 11 ft. 6 in. long, as in Fig. 30, which also indicates how the slope of the roof-boarding is intended to be flattened out a little for effect by means of a small piece or "sprocket" E on each rafter, which, however, is not essential. Intermediate rafters should subsequently be fitted, as at F and G in Fig. 24, and had better be stiffened and held in position by horizontal "collars" spiked on their sides, as at H in Fig. 26. If at this stage the framework be found at all lacking in rigidity, this defect can be entirely obviated by filling in diagonal "braces" as indicated by the dotted lines in Figs. 24 and 25.

Uprights about 2 in. by 2 in. or a little less will be required, as at J, K, and L in Fig. 27, and an intermediate horizontal rail, as at M (Fig. 24), should be filled in all round the back and ends, which can then be covered with vertical boarding nailed on the outer face of the framework, the two small spaces, as at N (Fig. 25), being only filled in with two pairs of plain square balusters each as shown, a treatment which could also be partially continued along the front if desired. An appearance of finish is imparted by the introduction of six shaped brackets of the outline shown in Fig. 31 and 1 in. thick, where shown on the uprights.

The roof and gable-ends can easily be filled in with feather-edged weather-boarding on the framework, either with or without the turned terminal shown added in the centre of the ridge, and overhung to form dovecotes or not as desired. As a matter of fact, the additional projection shown at the apex will be found a great help to the general effect, whether intended to be fitted up for birds or not. Details of the cotes will be found in Figs. 32, 33, and 34, where it will be observed that the horizontal shelves are fixed, while the fronts can be taken out in order to obtain access to the interiors for cleaning purposes; they can easily be fastened by means of small turn-buckles.

The site should be rendered as dry as possible, and the whole of the wood

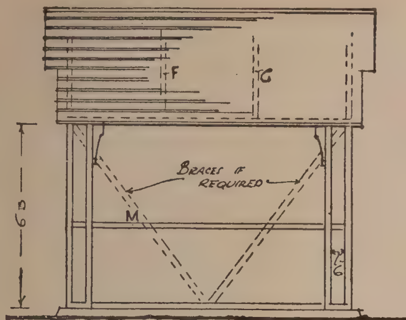


Fig. 24.

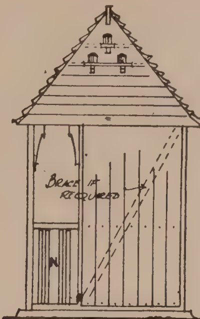


Fig. 25.

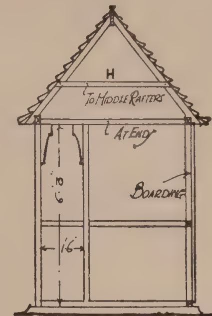


Fig. 26.

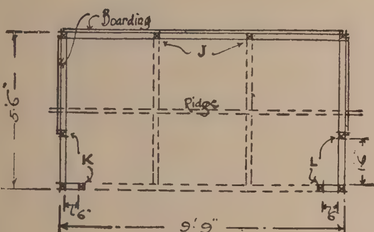


Fig. 27.

Figs. 24, 25, 26 and 27.—Front and Side Elevations, Transverse Section and Plan of Gable-roof Summerhouse with Pigeon Cote

Scale for Figs. 24, 25, 26 and 27

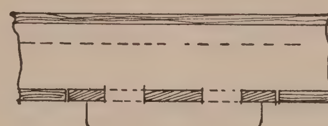


Fig. 34.—Plan of Lower Tier of Cote

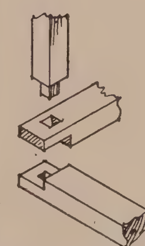


Fig. 28.—Sill Halved at Angle and Upright Stub-tenoned into it

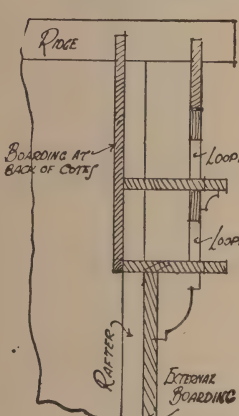


Fig. 32.

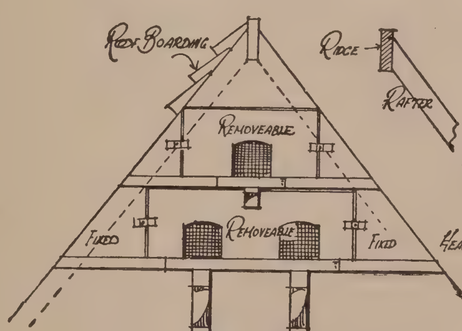


Fig. 33.

Figs. 32 and 33.—Longitudinal Section and Front Elevation of Cote

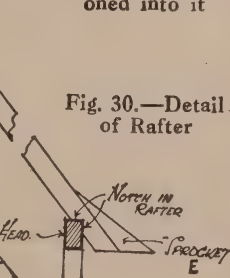


Fig. 30.—Detail of Rafter

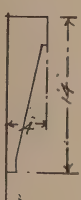
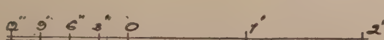


Fig. 31.—Outline of Brackets



Scale for Figs. 28, 30, 31, 32 and 33

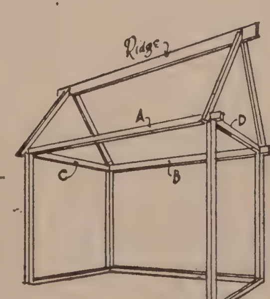


Fig. 29.—Main Framework of Summerhouse

thoroughly painted or protected by means of stain or varnish.

GABLE-ROOF SUMMERHOUSE WITH DOOR AT END

A summerhouse with gable roof, and of a different style from those previously described, is shown by the illustration (Fig. 35).

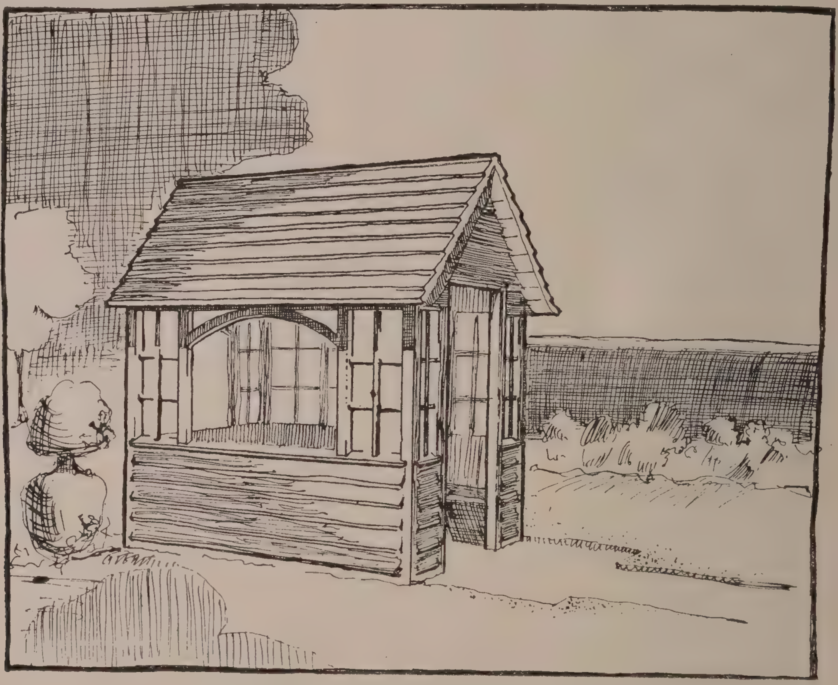


Fig. 35.—Gable-roof Summerhouse with Door at End

Figs. 36, 37, and 38 show front and end elevations and plan respectively.

The dimensions given will meet ordinary requirements, but can be altered as desired.

The posts and rails of the framework should be of 3-in. by 3-in. stuff, with 3-in. by 2-in. intermediate uprights, and after being planed to size should be set out and mortised and tenoned together. The lower part of the framework can be covered with 1-in. feather-edged boarding, with either fillets to cover the corners or the corner posts rebated to receive same as shown. If machine-prepared, the backs of the boards should be smoothed off. The curved piece at the top of the opening should be cut to shape and framed to the uprights. The rafters should be of 3-in. by 2-in. stuff, spaced about 1 ft. 4 in. apart if the top ends of the rafters are fixed to a ridge board about 1 in. thick. The roof should be of 1-in. feather-edged boarding. Some light sashes, made to fit the openings and to fasten to the posts, will be useful in windy weather.

When finished, two coats at least of wood-preserving stain should be applied.

EXTENSIBLE SUMMERHOUSE

The type of summerhouse shown in front elevation by Fig. 39 and in section and plan by Figs. 40 and 41 fulfils a dual purpose. Thus for the hot weather the comparatively large size, for a shelter, of 19 ft. by 7 ft. can be obtained (assuming that

the dimensions given on the illustrations are adhered to), and in cooler weather the structure can be reduced to quite an ordinary size by lowering the side pieces.

Reference to the illustrations will show section as the uprights, are tenoned into them in the ordinary way on all four sides, and at the top three pairs of 2-in. by $1\frac{1}{2}$-in. rafters and a light ridge board are nailed in position. The ridge should project 8 in. or 9 in. at each end. Next,

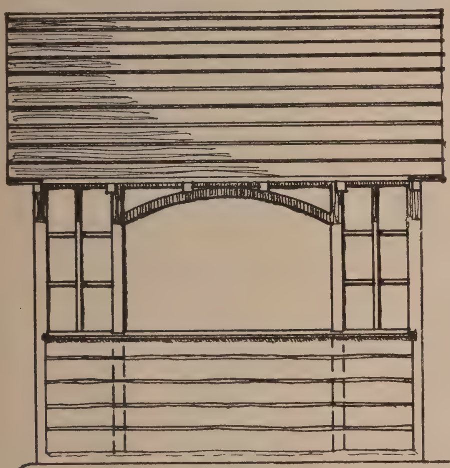


Fig. 36.

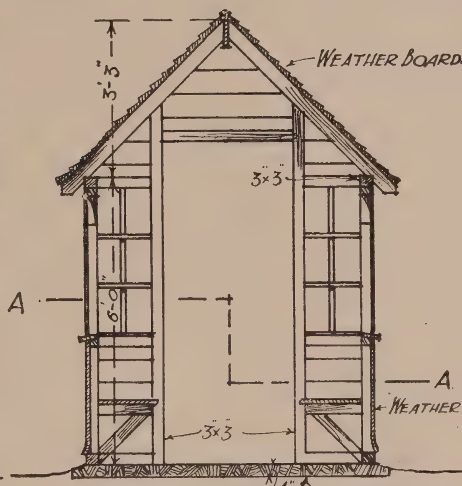


Fig. 37.

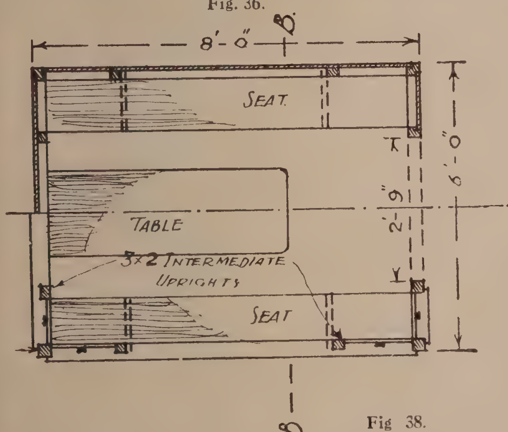
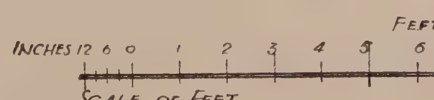


Fig 38.



Figs. 36, 37 and 38.—Front Elevation, Section (at B B) and Plan (at A A) of Gable-roof Summerhouse

the main dimensions suggested, and the construction may be briefly described as follows :—Fig. 42 is a rough sketch of the framework, of which the four uprights (shown on plan at A, Fig. 41) can be 3 in. by 2 in. or a little less. These should have their ends tarred and bedded in concrete if possible. A sill B (Figs. 39 and 42) and head C (Fig. 42), of the same in order to add an effect of solidity to the two front uprights, two other pieces about 2 in. by 2 in. or $1\frac{1}{2}$ in. by $1\frac{1}{2}$ in. are fixed against them in the manner shown at D in Figs. 39 and 41. These should butt tightly against sill and head, and between them immediately under the head is fixed a 1-in. board, cut to about the arched outline shown in Fig. 39.

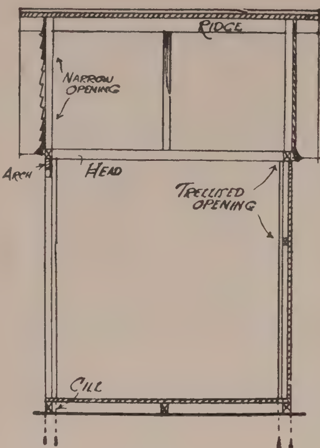


Fig. 40.

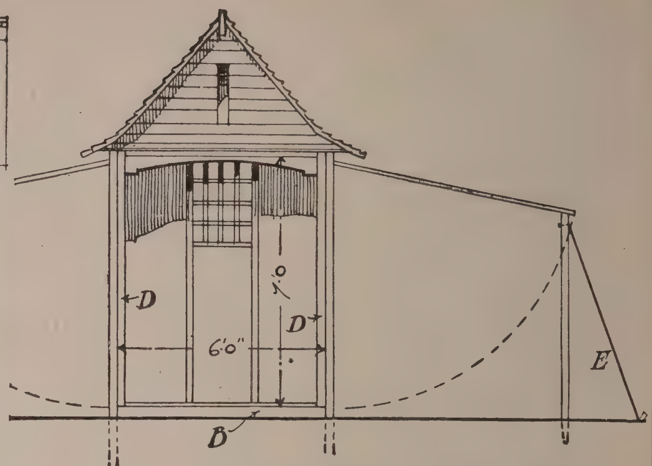


Fig. 39.

Figs. 39 and 40 (above).—Front Elevation and Section along Ridge of Extensible Summerhouse

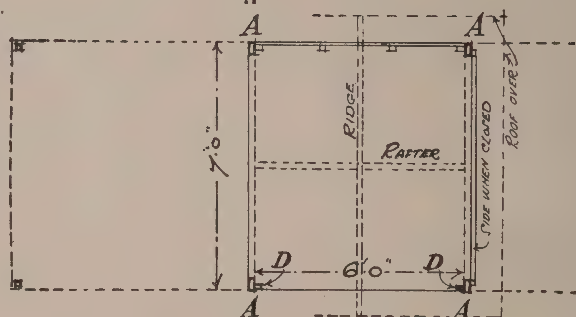
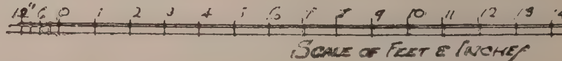


Fig. 41

Fig. 41 (to left).—Plan of Extensible Summerhouse Framing, showing Roof, etc., in dotted lines



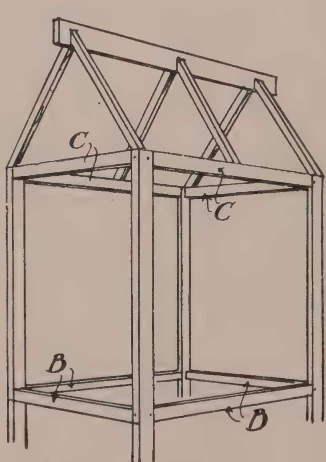


Fig. 42.—Main Framework of Extensible Summerhouse

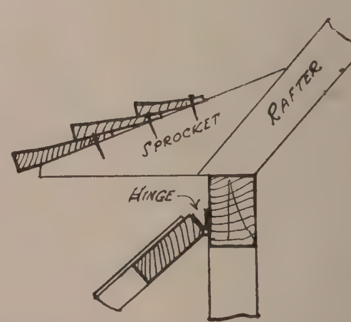


Fig. 43.—Enlarged Detail of Eaves to Roof over Central Part, and Hinged Top of Side Enclosure

This should be placed about $\frac{1}{4}$ in. back from the face of the pieces D, which should in turn be another $\frac{1}{4}$ in. back from the face of the 3-in. by 3-in. angle-posts.

The back of the structure is fitted with two intermediate uprights and two small fillets against the angles to take boarding, either feather-edged or matched; but should the latter be decided on, the intermediates should be arranged horizontally. The effect will be improved if a rectangle in the back is filled in with strips or laths to form a sort of trellised opening or window, fairly high up.

A couple of uprights should be fitted in the gable-ends, which can then be covered in with weather-boarding, tilted out a little on small triangular fillets along the bottom edges, in order to prevent a flat effect, and leaving a small lancet opening in the centre (Fig. 42). The feet of the rafters are splayed off to the correct angle, so that they may butt against the head on which they are supported, as in Fig. 43; but the roof should be curved out along the eaves by means of triangular "sprockets" fixed on the rafters as in the same figure. A strip of moulding should also be fixed along the inside of the junctions between the boarding on each side and the ridge, to break the joint.

It will be necessary to make the sides as light as possible in order to simplify the handling of them when in use; $2\frac{1}{2}$-in. by 1-in. stuff would be suitable for the frames, halved together at the angles, and with any necessary cross-pieces to take the covering, which it is suggested might, for the sake of the lightness, be of Willesden or similar material, or indeed of stout canvas. Three hinges will be advisable for each side, and the joint need not be particularly close-fitting, as it is well over-lapped by the projecting eaves of the central part. Of course, the chief trouble likely to be encountered is that of the side portions twisting in the sun, and to prevent this, well-seasoned wood should be obtained. The uprights to support the opened sides may be of any light section, and should have projecting pins at their top ends, fitting into sockets in the frames, and in exposed positions it may be found advisable to have guy-ropes to pegs in the ground, as at E (Fig. 39).

The boarded floor to the central part, if adopted, should be laid on the sills already mentioned, with any additional bearers found necessary added between, unless it is preferred to have the floor in removable sections, when it might be in three divisions held together at the back with battens or ledges. The flooring will require cutting to fit round the angle-posts.

It will hardly be necessary to insist on the imperative need of proper protection for such a structure, by thoroughly painting it, or treating it with some efficient tar stain, or other preservative.

REVOLVING SUMMERHOUSE

A summerhouse that can be turned according to the direction of the wind makes it very comfortable and pleasant to sit in, even well into the autumn. The one about to be described is large enough to accommodate a reclining chair, or two or three persons at tea. It is constructed of ordinary deal and such materials as are readily bought at any neighbouring woodyard.

Figs. 44 and 45 show an elevation and section. The method of building is as follows:—A hole 1 ft. 6 in. square by 1 ft. deep is first dug at a suitable place, and in this a 2-in. iron pipe is placed standing upright. Concrete in now poured round the pipe and then left for several days to dry.

In the meantime the track on which the wheels carrying the house will have to run may be taken in hand. Fig. 46 is a plan of the track. A 1-in. board 11 in. wide is placed on the floor of an available room, and a nail temporarily driven into the floor to represent the centre on which the house revolves. A piece of string is then attached by one end to the nail, and at the correct lengths of the string a bradawl attached to the other end, by which as much of the inner and outer curvature of the track as the 11-in. board will permit is scribed on the board,

the ends of the segment being marked off radially with the nail. This forms the template for cutting out the remainder of the segments for the track, sixteen being required. The segments are then placed in their proper positions, relatively one to the other, taking care that the radial joints at the ends of the segments in the top course break joint with the radial joints of the segments of the lower course. The courses are then nailed together piece by piece, using 2½-in. french nails, and turning the points well over the underside of the lower course.

The track when finished should be very rigid. It is now placed on the lawn, the pipe centre standing approximately in the centre of the track. To get this truly central, a piece of string or wire looped at one end and passed over the pipe serves to measure the distances diametrically from the pipe to the outside edge of the track, say, across two imaginary diameters to get four measurements. The track is then moved about until all four measurements are equal and the track central with the pipe centre. Four holes the size of an ordinary broomstick are next bored through the track, and four pegs cut from a broomstick driven down through these holes into the lawn below, thus retaining the track in its central position.

The next part to be dealt with is the large square framing forming the foundation of the house, and to which the upright posts are to be attached, also the flooring and the wheels, which have to take the whole weight of the house.

Fig. 47 is a plan of the framework under the floor. The sides, at their ends, are dovetailed into the ends as shown, the dovetails then being spiked or screwed. Two beams running from the front to the back are next halved into the top edges of the main frame, and between these two beams a block of wood with a 2-in. hole is fitted. This forms the bearing and keeps the house rotating in its proper position when turned. These two beams perform the double function of supporting the floorboards, and also of keeping the house in its proper position relatively to the track. The wheels and their supports are next fitted. Cast-iron wheels of 8 in. in diameter are suitable. They are fitted between two diagonal beams, which are let into the underside edges of the main frame.

The four corner posts may be next erected and secured inside, the corners of the main frame having first been mortised for the middle string and checked back for the top string. The rafters are cut at one end to the proper angle, and notched near the other end to give proper landing on to the upper corner edge of the top string. The purlin is then put temporarily in position, and the rafters secured thereto, one by one. The posts forming the entrance to the house and their horizontal framings are now secured, the former being fastened to the inside of the main framing, and the latter being tenoned into the corner posts of the house. This completes the framing, and it is ready for planking.

The floor should be first laid and well secured by nailing to the main framing and the various beams. The back and sides should then be planked, taking care to get the plank edges well together before permanently driving in the nails. As shown, provision is made in the house sides for four windows, which are hinged at the top. These are made out of the same material as the sides of the house.

The roof is next put on, and, after planking, should be well painted. Whilst the paint is wet, stout canvas is well stretched on and given two coats of paint. The gable is now put in position, and the house being finished, the inside may be treated with best copal varnish, and the outside given three coats of oil paint.

The scantlings of the material necessary are as follows:—Roof: grooved-and-tongued boarding, 5 in. by ⅝ in.; rafters, 2½ in. by 2 in.; gable A, 5½ in. by ¾ in. Framing: top string B, 3 in. by 3 in.; middle string C, 3 in. by 2 in.; corner posts D, 3 in. by 3 in. Flooring: side and end planking, 5 in. by ⅝ in., grooved and tongued; nosing round entrance framing E, 4 in. by ¾ in.; beams under flooring carrying centre block, 5½ in. by

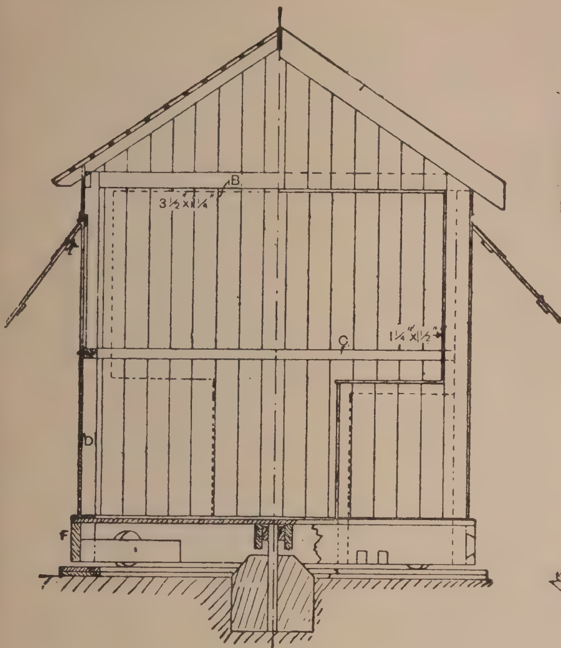


Fig. 44.

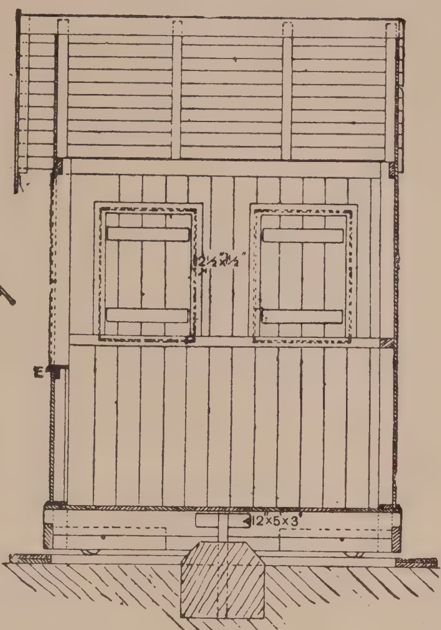
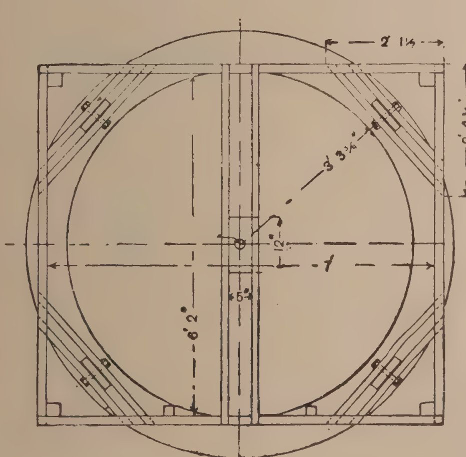


Fig. 45.

Figs. 44 and 45.—End Elevation and Section of Revolving Summerhouse



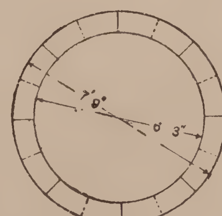


Fig. 46.—Plan of Track

Fig. 47.—Plan of Framework under Floor

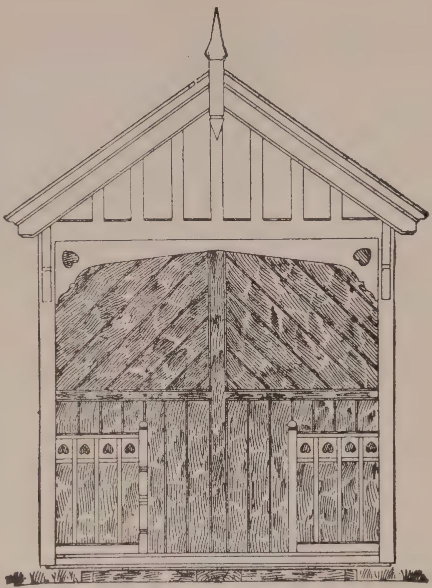


Fig. 48.

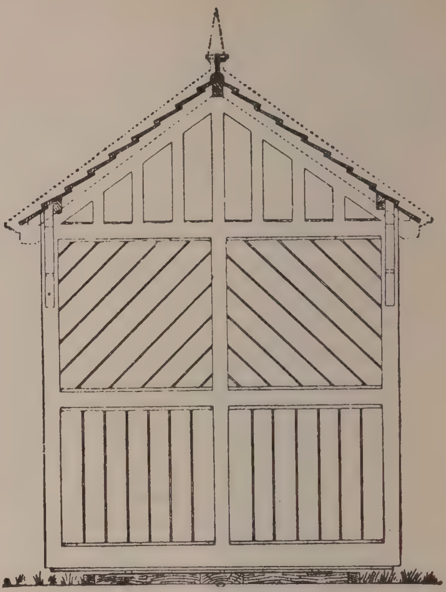


Fig. 49.

Figs. 48 and 49.—Front and Back Elevations of Portable Revolving Summerhouse

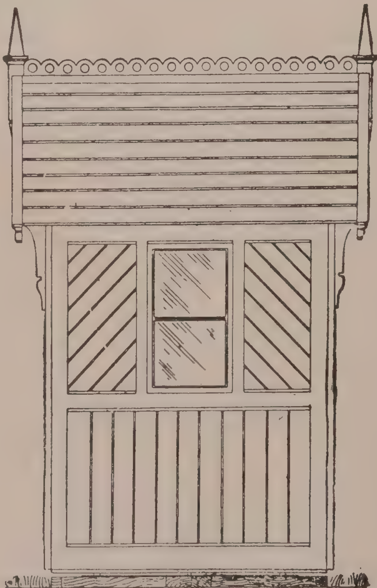


Fig. 50.—Side Elevation of Portable Revolving Summerhouse

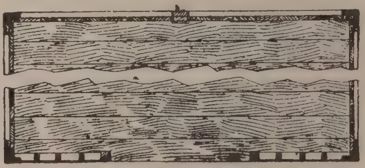


Fig. 51.—Part Plan of Roof

Fig. 52.—Floor Framing with Rollers Attached

$1\frac{1}{2}$ in.; main framing round base of house F, $8\frac{1}{2}$ in. by 2 in.; wheels of cast-iron, 8 in. in diameter; bolts for wheels, 1 in. in diameter; and beams for wheel centres, 5 in. by 2 in.

PORTABLE REVOLVING SUMMERHOUSE

Another design for a revolving summerhouse is shown by Figs. 48 to 51.

Pine or deal are suitable woods for construction, and the inside lined with 1-in. or $\frac{3}{4}$-in. matchboarding. The latter is arranged with the joints as showing outwardly, and where the perpendicular and angular pieces meet, strips of $\frac{1}{2}$-in. stuff may be nailed on, as shown in Fig. 48. The outer framing may be made of $1\frac{1}{2}$-in. or $1\frac{1}{4}$-in. stuff, tenoned and mortised together, and the horizontal rails bevelled to carry off the rain. The panels in the gables may be inserted in grooves ploughed in the framing. As a portable structure is desired, the roof with the gables should be made in one part, allowing the ridge and wall-plates and the outer rafters to butt against the barge-boards, and thus form a groundwork for fixing the latter. The wall-plates should be arranged to drop inside the upright framing, the latter being notched to receive the rafters. Instead of the rafters being cut away to receive the feather-boards of the roof as shown, the feather-boards may be simply laid on the top of the rafters. To make a good weathertight roof, roofing felt should first be nailed across the rafters, and then the feather-boards on the top.

The framing for the floor (*see* Fig. 52) may be made of 3-in. planks, with 1-in. floorboards. The rollers are fixed on the cross-bars. A thick iron plate with a hole in the centre is fixed to receive the centre bolt, say, 1 in. in diameter. The latter is fixed in the lower framing (made of 3-in. stuff), on which is fixed stout sheet iron to form the roller track (*see* Fig. 53).

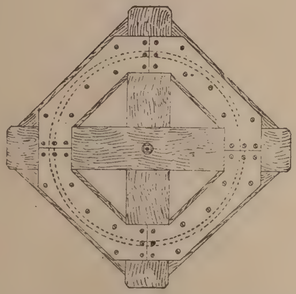


Fig. 53.—Underframing with Iron-plate Roller Track

Fig. 54.—Enlarged Sectional Plan of Corner Upright

Fig. 57.—Bracket

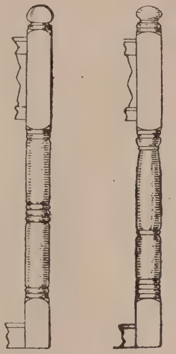


Fig. 55. Fig. 56.

Figs. 55 and 56.—Two Designs for Balusters

These plates, if desired, may be made in sections of a circle. It will be seen that the outer upright framings fit against the floor framing, and the inner matchboarding rests on the floorboarding. Instead of the corner iron brackets being fixed with screws as shown, bolts may be used; but in this case the bolt heads will show outside. Fig. 54 gives an enlarged sectional plan of a corner upright, Figs. 55 and 56 give alternative designs for the balusters, and Fig. 57 shows the brackets fixed to the corner posts.

The inside matchboarding may be varnished, and as an alternative for the outside the panels in the gables may be white, and the matchboarding alternating pale green and white.

Garden Rooms or Bungalows

GARDEN ROOM

To what extent this type of garden room or bungalow can be erected depends on the garden, and the requirements of such an erection.

Fig. 1.—Garden Room

The illustration (Fig. 1) shows how a modern type of summerhouse can be adapted to the cult of the open-air life. In its arrangement it has been made as far removed as possible from the haunts for spiders, so often encountered, and it is capable of being kept in a perfectly hygienic condition. It consists of a room 15 ft. by 10 ft. 6 in., with glass doors opening on to a small veranda enclosed by treillage, and it should be so placed as to command the sunniest outlook available, and be in a fairly dry situation. It is thought that although the design and construction may be varied to suit particular circumstances, the following description and notes will be found generally useful.

Front and end elevations are shown

Fig. 2.

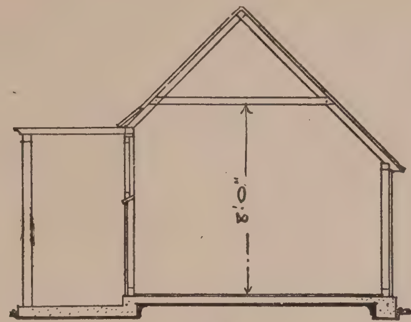


Fig. 3.

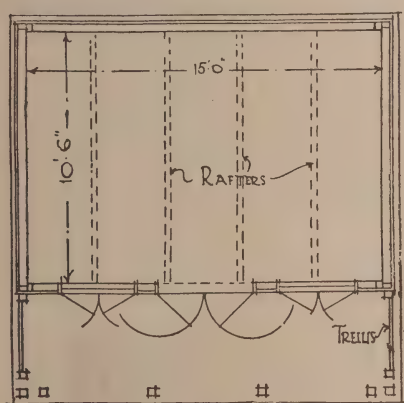


Fig. 4.

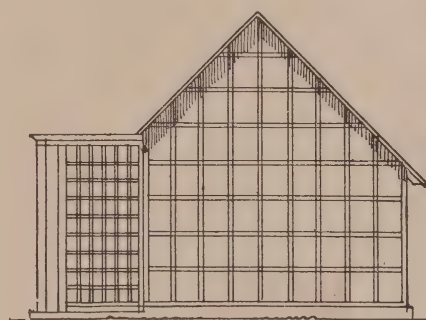


Fig. 5.

Figs. 2, 3, 4 and 5.—Front Elevation, Transverse Section, Plan and End Elevation of Garden Room

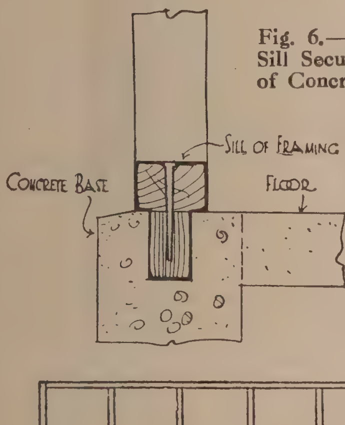


Fig. 6.—Section of Sill Secured to Top of Concrete Edging

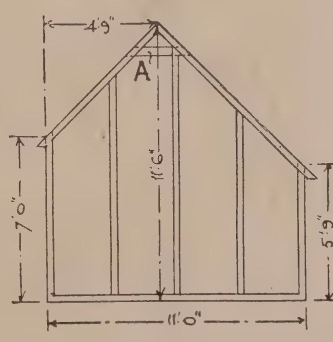
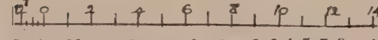


Fig. 7.—Elevation of End Framing



Scale of feet and inches for figs. 2, 3, 4, 5, 7, 8 and 9

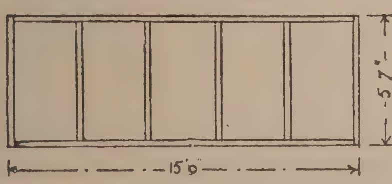


Fig. 8.—Framing for Back

by Figs. 2 and 3, and a plan and transverse section is shown by Figs. 4 and 5.

As a foundation, in some cases it may be sufficient to use a layer of well-rolled gravel, ashes, or broken brick, to ensure being ultimately finished with tar or cement, and perhaps boarding nailed to small bearers about 2 ft. apart bedded on the layer. For permanence the undersides of the boarding, as well as of the

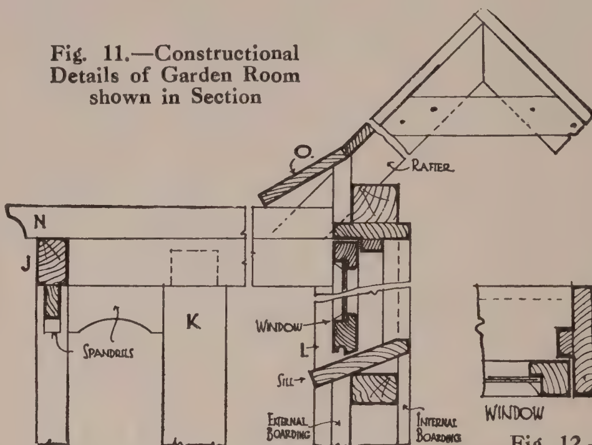


Fig. 11.—Constructional Details of Garden Room shown in Section

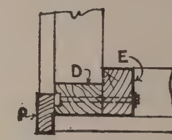


Fig. 10.—Enlarged Plan of Corner

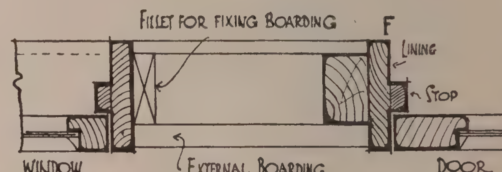


Fig. 12.—Enlarged Plan between Window and Door

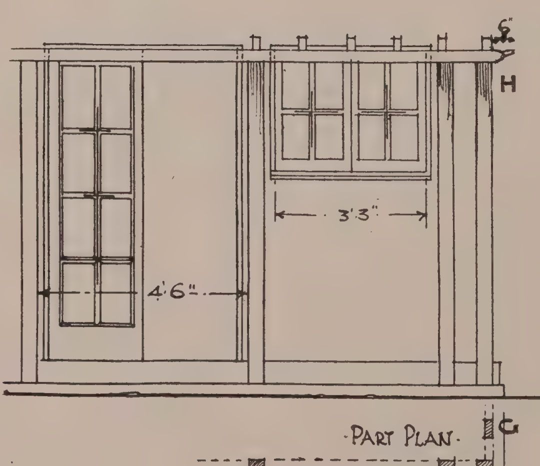


Fig. 13.—Enlarged Detail (Elevation and Part Plan) of Part of Front

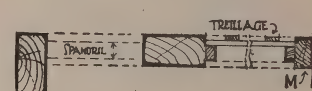


Fig. 14.—Plan of Part of Screen

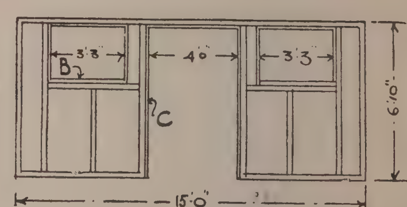


Fig. 9.—Elevation of Front Framing

Scale of inches for gs. 6, 10, 11, 12 and 14

comparative dryness under the structure. In this event, the top soil should be removed, stout pointed stakes driven well in and sawn off level to serve as fixing for the sides, and a good dry layer substituted for the top soil, its top surface hidden woodwork, should be well tarred. A better foundation could be formed by clearing the top soil as before and forming a rectangle of about 11 ft. 3 in. by 15 ft. 9 in. with boards, held in position with pegs in the ground. With

these as a guide, a base of rough concrete about 6 in. wide, and, say, 9 in. above the ground, could be readily formed, the woodwork being afterwards fixed to it by screwing or spiking to wooden blocks bedded in the top of the concrete at intervals round the sides, as in Fig. 6. Another method would be to bed about ten long bolts in the concrete, and to drill holes in the bottom of the framing to suit these, this method requiring considerable precision. At a later stage, the centre between the concrete edges might be filled in with tarred ashes, etc., or preferably about 3 in. of concrete finished to a smooth cement face by trowelling.

The floor should be level with the top of the concrete edging, the outside of which can be finished with cement or old tiles, etc., as a facing, and a step at the entrance being also treated in a similar manner. The paving to the veranda can be of concrete, or gravel bound with tar or cement, and should slope a little away from the doors.

In beginning the main structure the first things to consider are the sides, consisting of two ends (Fig. 7), a back (Fig. 8), and front (Fig. 9). These can be framed up very suitably with 3-in. by 2-in. rough-sawn timber, the outer parts halved together at the angles, and the intermediate uprights either tenoned or more probably merely spiked in position, their purpose being to stiffen the outer portions and to provide fixing for future boarding, etc. Note in Fig. 7 how the sloping rafters are held together by a piece of board nailed on at A, and how their lower ends project about 6 in., thus giving strength to the joints with the uprights. The dimensions shown in these three figures should be carefully worked to; the inner lines, as at B and C in Fig. 9, will be referred to later. The side in this figure could obviously only be put completely together when in its ultimate position.

Having prepared these skeleton sides they should be placed in position on the base already prepared, being supported by temporary sloping struts, and spiked, screwed or bolted through the bottom rails or sills. The angles should have two of the uprights coming together, as at D and E in Fig. 10, these when bolted and screwed fairly closely forming a very sound job, and tying the work together. Next, four sets of rafters exactly similar to those in Fig. 7 should be prepared, and birdsmouthed over the tops of the front and back, as in Fig. 3, and to a larger scale in Fig. 11, their tops being halved (Fig. 3) or merely mitred and secured as before (Fig. 11). The rafters are spaced out equally, as dotted in Fig. 4, and can be stiffened by means of light horizontal pieces nailed on to one side of each pair, 8 ft. above the floor, as clearly shown in Fig. 3.

The door opening can be treated with 1-in. planed linings about $4\frac{1}{2}$ in. wide, as at C in Fig. 9 and F in Fig. 12. To these $\frac{1}{2}$-in. stops can be fixed, to suit $1\frac{1}{2}$-in. doors of the ordinary type, which can be made or bought. They should be hinged flush with the outer edge of the linings in order to open back flat on occasion. The same remarks apply to the small windows with the exception of their sills, which, as seen in Fig. 11, consist of boards about $6\frac{1}{2}$ in. wide, fixed sloping on small triangular blocks.

Dealing next with the small pergola in the front, its posts need to be fairly wide for the sake of appearance; but if square would be rather heavy and costly. A compromise is accordingly suggested in Fig. 13 and Fig. 14, where 4-in. by 2-in. uprights are indicated, while even 3-in. by 2-in. might be allowed. Those on the return G (Fig. 13) could be omitted. All the uprights used should have well-tarred ends bedded in the ground, their tops being tenoned into a head about 3 in. by 2 in., having shaped projecting ends, as at H (Fig. 13). It is seen in section at J in Fig. 11, which shows also a similar head at the end, taking the top of the optional post K, and resting on a 2-in. by 1-in. upright L, seen on plan at M (Fig. 14). The heads should have their tops level with those of the windows, and are intended to support a series of cross-pieces about 2 in. by $1\frac{1}{2}$ in., spaced out

as shown on the various illustrations, and shaped and projecting slightly, as at N in Fig. 11, which also shows 4-in. by 1-in. shaped spandrel pieces intended to be fixed as a finish between the tops of the adjacent posts.

The roof should be covered in with feather-edged weather-boarding, or ordinary boarding covered with stout inodorous felt, tarred and sanded when in position. The roofing is intended to overhang well all round, and at the front to be slightly tilted, as at O (Fig. 11). The sides can also be covered with boarding, stopping against an upright batten at the angles, as at P (Fig. 10); or it would be an excellent idea to get a builder's man to lath and roughly cement-render them. Internally the whole can be lined with $\frac{5}{8}$-in. matched and V-jointed boarding, any necessary fixing fillets being added, as noted in Fig. 12, where it will be noticed that the linings to the door and windows project sufficiently to stop the inner and outer coverings, the former having mouldings fixed over the joints if desired. Externally, the treillage screens at each end of the veranda can be formed with stout plasterers' laths on small fillets, as in Fig. 14 while the larger work on the ends (and back if desired) can be composed of battens about $1\frac{1}{2}$ in. by $\frac{3}{4}$ in. crossing at right angles, the horizontal ones being applied last; if against the boarding they would form a lodgment for moisture.

Fig. 15.—Garden Bungalow

Two thorough coatings of some recognised wood-preservative should be applied throughout, the interior being varnished in addition. There are several such preservatives on the market which are well worth the expenditure.

GARDEN BUNGALOW FOR OPEN-AIR LIFE

For the most part the bungalow shown by the photograph (Fig. 15) is designed for permanent occupancy, although to most people it would appear to be something built for use only during a portion of the year. No doubt the climatic conditions of this country are such that the difference in purpose would involve something being done for the warmth of the apartment during the winter months. For an open-air cure, or for an ideal apartment for open-air life, no heating apparatus is required, and for that reason the construction of the bungalow only will be described.


Fig. 16.

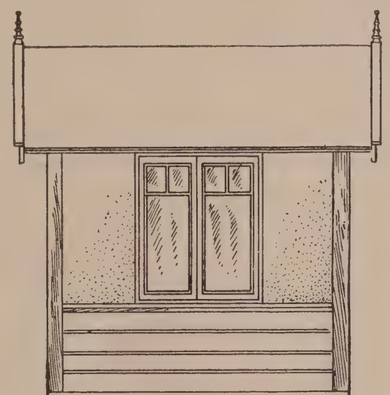


Fig. 17.

Figs. 16 and 17.—Front and Side Elevations of Garden Bungalow

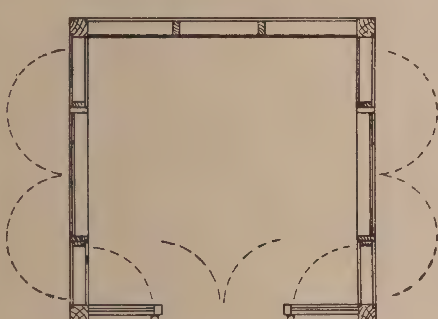


Fig. 18

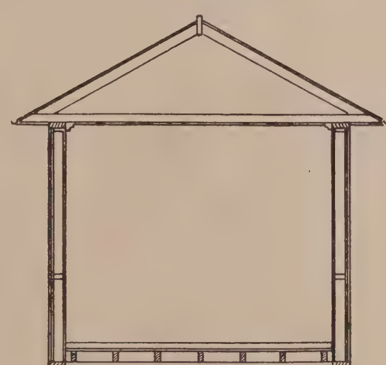


Fig. 19.

Figs. 18 and 19.—Plan and Transverse Section of Garden Bungalow

The illustration (Fig. 15) gives a general view of the finished structure, which is shown built on a wood staging raised from the ground about 2 ft. Figs. 16, 17, 18, and 19 show front and side elevations and plan and cross section respectively.

The treatment of the ground can be

similar to that for the preceding erection. The internal size of the room is 8 ft. by 8 ft., just sufficient to hold a single bed, a dressing-table, and two chairs. The plan shows the front arranged with folding doors which open to the inside, and two opening sidelights which can be folded round against the side walls. Thus when the doors are open and the windows folded round, for all practical purposes the front might be considered as entirely open. On both sides are double-casement windows which open to the outside, and are arranged so that they fold completely round. The framework, which is shown by Fig. 20, is of red pine and consists of a 6-in. by 2-in. frame half-checked at the corners. This in turn receives the wall framing. The corner posts are 4 in. square, and are checked, as shown in Fig. 21, to receive the weather-boarding. The other vertical posts and the top horizontal rail are cut from 4-in. by 2-in. stuff, and the lower horizontal rail is 5 in. by 2 in., for the reason that the outer edge is finished flush with the boarding. The framework as shown is complete ready to receive the windows and finishings.

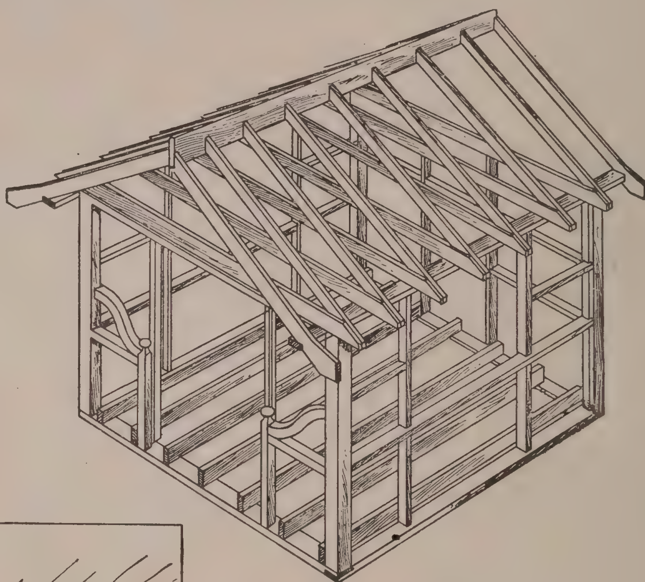


Fig. 20 —Framework for Garden Bungalow

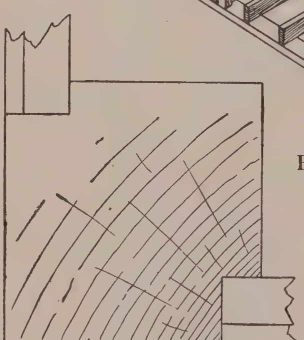


Fig. 21.—Enlarged Detail of Corner Post

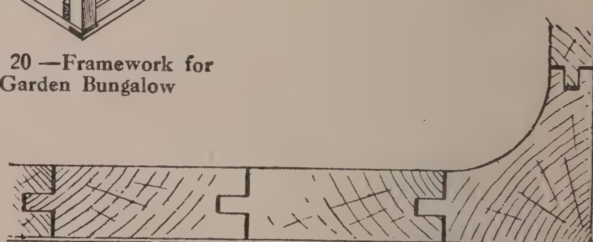


Fig. 22.—Enlarged Detail of Junction of Floor and Wall

The timbers for the roof are 3-in. by 2-in. spars and ceiling joists, 6-in. by 2-in. barge, and a 5-in. by 2-in. ridge. These are fitted up in the usual way to receive the $\frac{3}{4}$-in. matchboarding, which is covered with Ruberoid. The floor is laid with 5-in. by 2-in. joists, which are covered on the top with Willesden paper and laid with $1\frac{1}{8}$-in. flooring. Fig. 22 gives a detail of the floor at the junction with the wall linings. Paper similar to that placed under the floorboards is fitted behind the walls and ceiling linings.

Garden Lights

SIMPLE GARDEN FRAMES

The simplest form of cold frame is a small box or packing-case with a sheet of glass over it. These are useful enough, and have the merit of convenience and mobility, and a specially suitable reference to individual plant requirements. But the garden creates problems that these useful makeshifts do not touch.

box by means of butt hinges, and the whole thing is complete.

A window sash has no means of clearing its upper surface of water because the glass is surrounded by a raised wooden border; in other words, the stiles and rails. Therefore a properly-constructed sash for a cold frame should have one rail finishing under the glass; and further, the sash should have a fall, as in a roof,

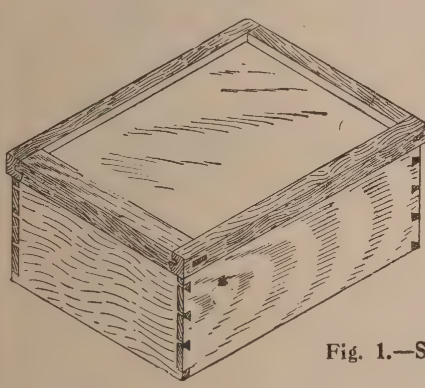


Fig. 1.—Simple Cold Frame

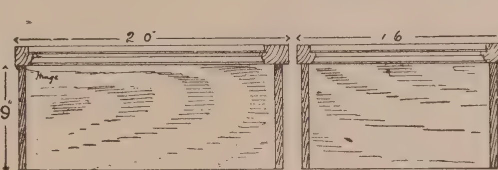


Fig. 2. Fig. 3.

Figs. 2 and 3.—Longitudinal and Cross Sections of Simple Cold Frame

Cold frames can be of all sizes and shapes. Old sashes can be used in making them. To do this, a box can be made as shown in Figs. 1, 2, and 3, which give particulars of how to fit up a box for a single-light sash. It is not necessary that this box should be made to take to pieces, as it is small enough to be easily portable. The sash can be hung to the

to enable water to run off. Figs. 4, 5 and 6 show such a small frame. The bottom rail finishes on its upper surface just at the beginning of the glass rebate.

The joint at the junction of the top rail and stile is shown by Fig. 7, and the joint at the junction of the stile and the bottom rail by Fig. 8. Dowels should be

used for fixing the joints, white-lead paint being used as a binding medium.

Sometimes it is required to have the sash so that it can be taken off, and in this case a slide arrangement is necessary. This is shown by Fig. 9, which is a section of the stile of the sash, side of the frame and slide piece. It as an advantage to have this slide piece even if the sash is hinged, because it makes the cold frame more air-tight, and consequently warmer.

When the sash is loose it is apt to be caught by the wind and blown off. This is easily guarded against by fixing wooden buttons on the frame, as shown in Fig. 10. In the case of a frame with a hinged sash a stick is needed to keep the sash raised when necessary. For a larger cold frame the sash will require bars.

In glazing a frame, each succeeding upper square of glass should overlap the next lower one by about $\frac{3}{4}$ in., and each

Fig. 4.—Improved Type of Cold Frame

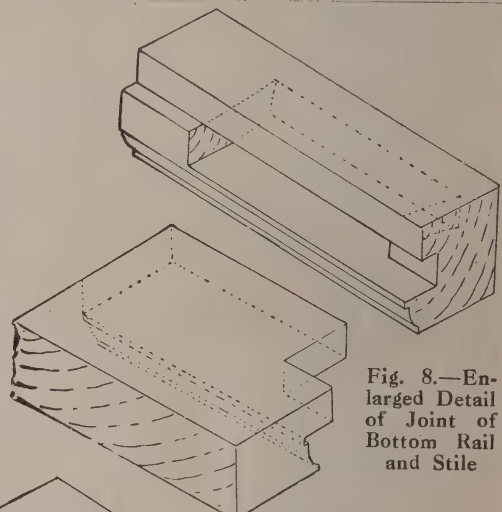


Fig. 8.—Enlarged Detail of Joint of Bottom Rail and Stile

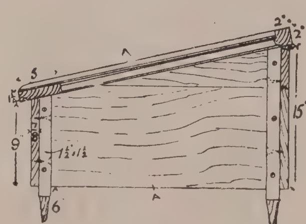


Fig. 5.

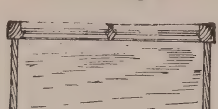


Fig. 6

Figs. 5 and 6.—Longitudinal and Cross Sections of Improved Cold Frame

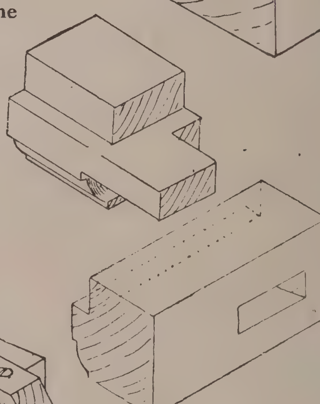


Fig. 7.—Enlarged Detail of Joint of Top Rail and Stile

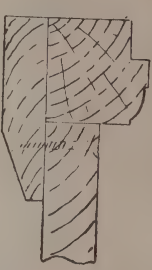


Fig. 9.—Cross Section of Stile

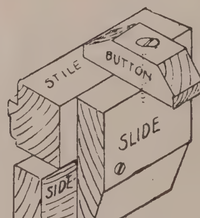


Fig. 10.— Stile, Slide and Button

pane should be tacked at its lower end to prevent slipping. The sash, if of any size, should have a handle fixed on the top rail to assist in moving it. To protect the glass from stones, wire-netting of $\frac{3}{4}$-in. mesh may be stretched across.

For fixing the cold frame, stakes are driven into the ground so that they lie in the angles of the frame, and the latter is screwed to them.

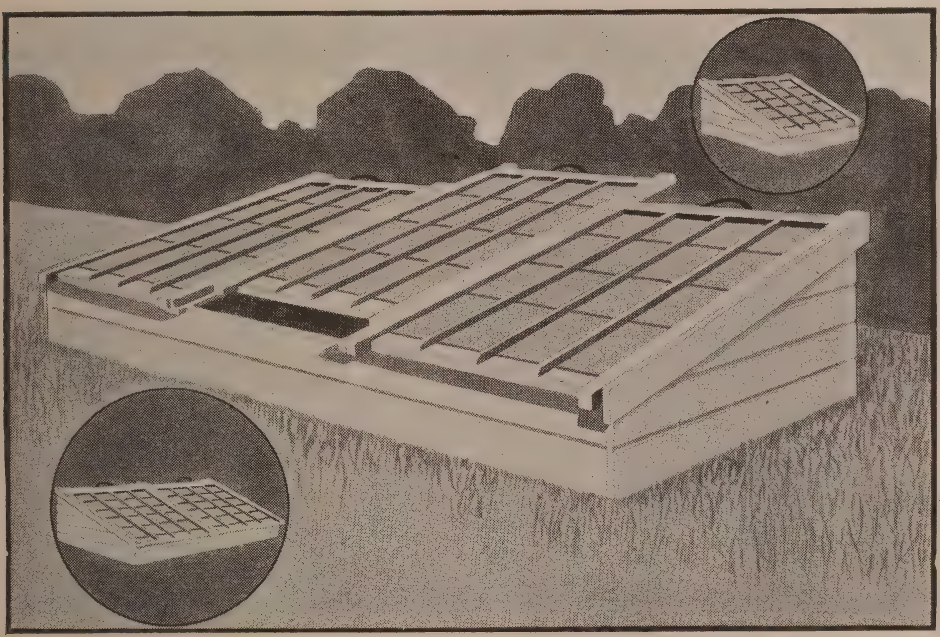


Fig. 11.—Three-light Garden Frame (Inset, One- and Two-light Frames)

GARDEN FRAMES OF SPECIAL CONSTRUCTION

Specially constructed garden frames are usually made with one, two or three lights. A three-light frame is shown by Fig. 11, and the insets in this figure show frames with one and two lights. The constructional work of these frames is of a fairly simple character.

The frames shown have sliding lights, and prove very satisfactory in use. The lights may be either 4 ft. by 3 ft. or 6 ft. by 4 ft. With the smaller lights frames can be made to the following sizes: One light, 3 ft. long by 4 ft. wide; two lights, 6 ft. long by 4 ft. wide; and three lights, 9 ft. long by 4 ft. wide. With the larger lights: One light, 4 ft. long by 6 ft. wide; two lights, 8 ft. long by 6 ft. wide; and three lights, 12 ft. long by 6 ft. wide.

The lights are made as shown in Fig. 12. It will be noticed that the bottom rail is thinner than the stiles and top rail, this being to allow the glass to come over it, so that the water will run away, while a throating should be cut in the underside to prevent the water running back and into the frame. A tie rod of $\frac{1}{2}$-in. round iron, fixed across the light, as shown in Fig. 12, will greatly strengthen it.

The body for a three-light frame is shown in Fig. 13; but the construction in the case of a one-light or two-light frame is almost identical. A section through the frame is given by Fig. 14, and the sectional dimensions for a frame to suit either the smaller or larger lights are given in Figs. 15 and 16. Grooved-and-tongued boards not less than $1\frac{1}{8}$ in. thick should be used. Those for the

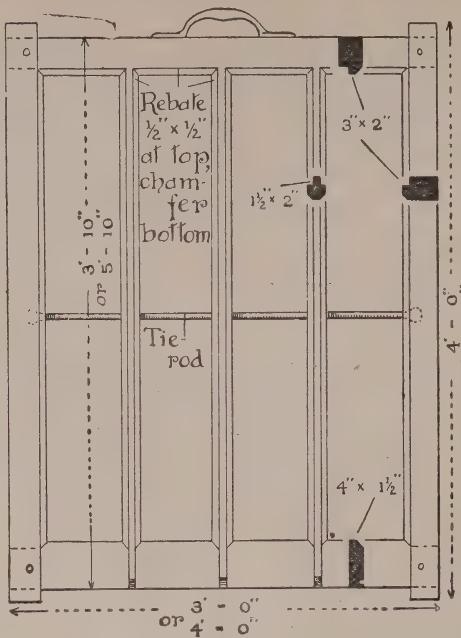


Fig. 12.—Plan of Light

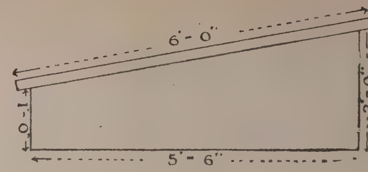


Fig. 16.

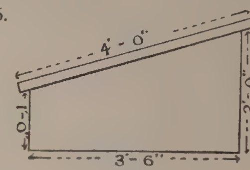


Fig. 15.

Figs. 15 and 16.—Side and End Elevations of Garden Frame

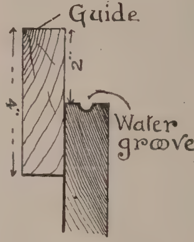


Fig. 18.—End Guides

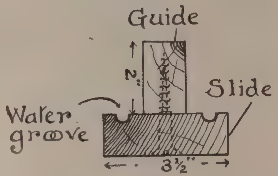


Fig. 19.—Inner Slides and Guides

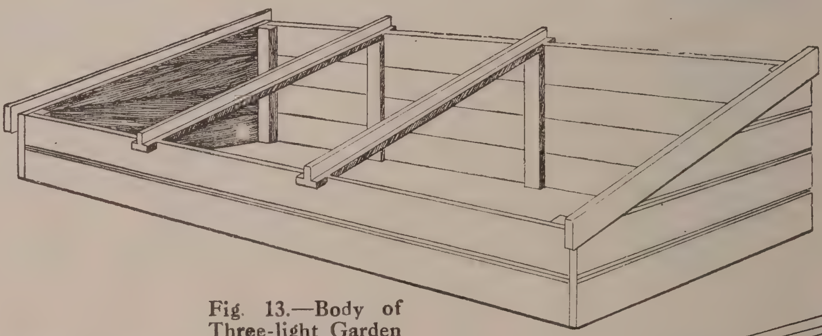


Fig. 13.—Body of Three-light Garden Frame

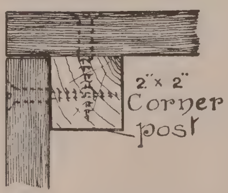


Fig. 17.—Corner of Frame

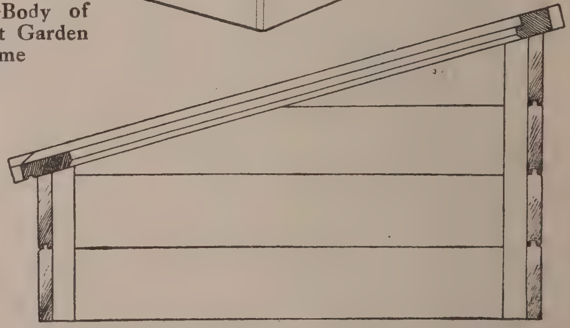


Fig. 14.—Transverse Section of Garden Frame

sides are cut to shape, and 2-in. corner posts are screwed $1\frac{1}{8}$ in. in from the ends, as shown in Figs. 14 and 17. Water grooves could be cut at the top edges of the sides, as clearly shown in Fig. 18. The front and back boards are screwed to the corner posts which have been previously fixed to the sides, as shown in Fig. 17. In two-light or three-light frames the front and back could be strengthened with cross-battens, as shown in Fig. 13.

In two-light or three-light frames the inner slides and guides are formed as shown in Figs. 13 and 19, water grooves being cut in the slides. For the guides at the ends see Fig. 18.

Deal may be used in constructing the frames; but being exposed to the weather all the joints should be put together with white-lead paint.

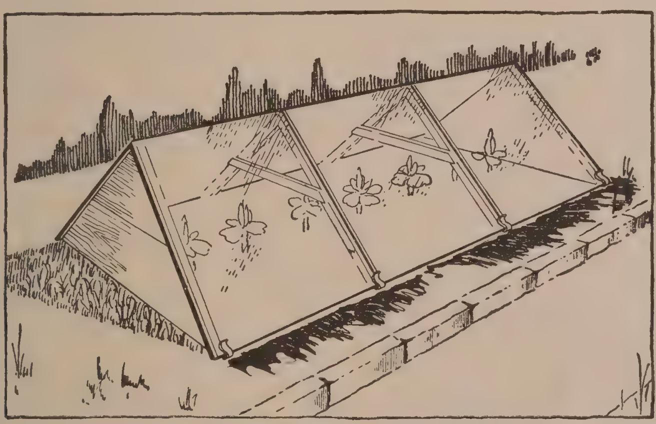


Fig. 20.—Extensible Garden Frame

EXTENSIBLE GARDEN FRAME

An extensible garden frame of simple construction is shown by Fig. 20. The frame is made in parts, and could be fitted up on any desired spot. There must be two wood ends, and a number of inner frames, which are covered with loose sheets of glass. The glass is not fixed in any way, but simply rests on the ends and frames, and is held at the bottom by small metal clips, which are fitted at the corners of the ends and frames. The frames of glass measure 1 ft. 6 in. square, and the length of the frame could be extended according to the number of frames available.

Fig. 21 shows the sectional dimensions of the frame to which the ends and inner frames should be made. The ends (Fig. 22) are of $\frac{1}{2}$-in. boards, preferably grooved and tongued, and held together with two battens 1 in. square nailed in position. Two wood stakes 1 in. square are fitted to each end for fixing in the earth; they are pointed, and project about 6 in. The inner frames (Fig. 23) are of wood 1 in. square, half-lapped and screwed together at the top, as shown in Fig. 24, and kept from spreading by a cross batten, which should be 1 in. deep by $\frac{1}{2}$ in. thick, screwed in position. The bottom ends of the frames are cut to a point as shown. The metal clips could be of either thin iron or steel 1 in. wide, and shaped as shown by Fig. 25. The clips are let in flush with the edges of the ends and frames, each being fixed with two screws.

The wood and metal parts of the frame should be kept well painted.

HAND LIGHT

A hand light has many advantages over the larger garden frame, and by its use seeds may be raised on the site they are

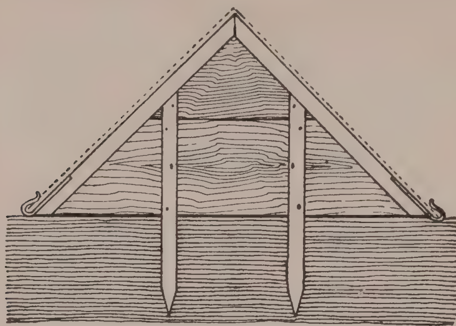


Fig. 22.—End Elevation of Extensible Garden Frame

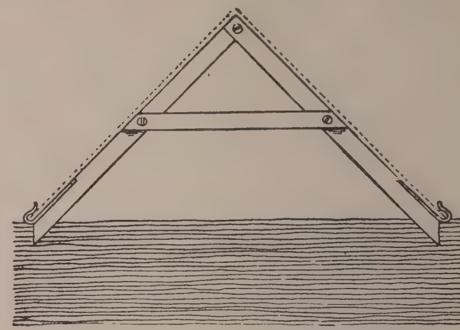


Fig. 23.—Elevation of Inner Frame

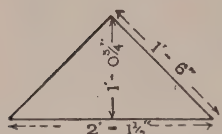


Fig. 21.—Sectional Dimensions

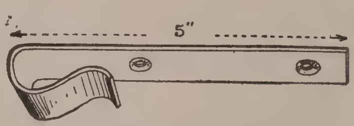


Fig. 25.—Metal Clip

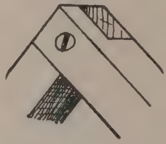


Fig. 24.—Joint at Apex of Frame

permanently to occupy. It may be used for forcing vegetables and small salads in their permanent positions, and with glass on each side the contents of the light receive a maximum amount of heat and sunshine which is very beneficial.

Fig. 26 is a general view of the light, and Figs. 27 and 28 are side and end elevations. A cross section is shown by Fig. 29. The ends A (Fig. 30) are made from ½-in. boards to the sizes given in Fig. 31. The boards should, preferably, have grooved-and-tongued edges, and they are held together with two battens B. The battens are 2½ in. wide by ½ in. thick, and the upper edges project ½ in. above the edges of the ends to form rebates for the glass. Two small battens C (Fig. 31), which are 4 in. long by 1½ in. wide by 1 in. thick, are fixed to the ends 1 in. in from the edges to carry the side rails D. The side rails are 2 ft. 5 in. long by 4 in. deep by 1 in. thick. The top edges are bevelled to match the ends, and they are fixed to the battens C. Small angle-plates fixed in the corners between the battens C and the side rails D would greatly strengthen the work. The top rail E is 2 ft. 10 in. long by 2½ in. deep by 1 in. thick. Notches are cut in the underside to fit over the ends of the light, and the ends of the rail are rounded.

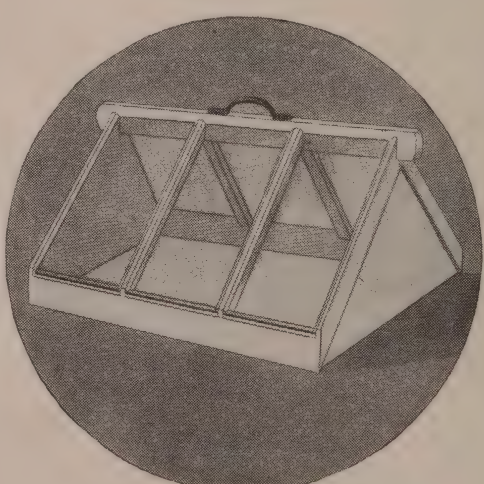


Fig. 26.—Hand Light

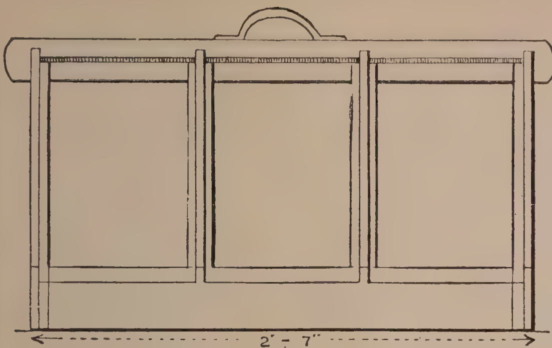


Fig. 27.

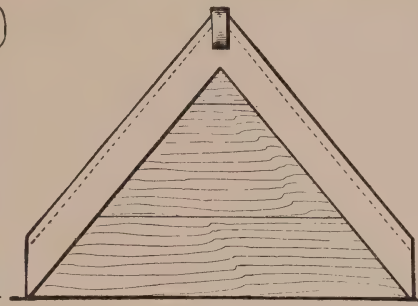


Fig. 28.

Figs. 27 and 28.—Side and End Elevations of Hand Light

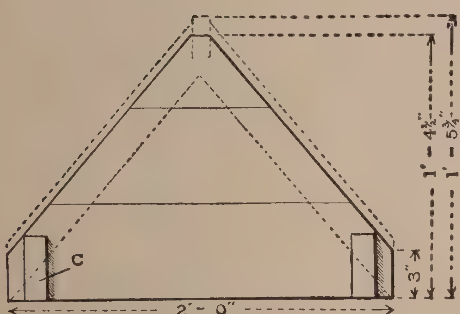


Fig. 31.—Dimensioned Details of End

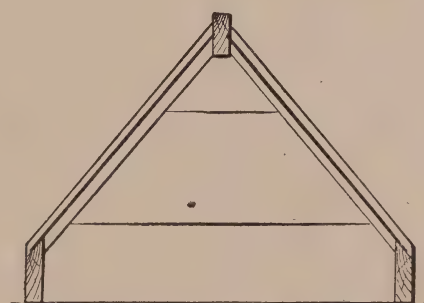


Fig. 29.—Cross Section of Hand Light

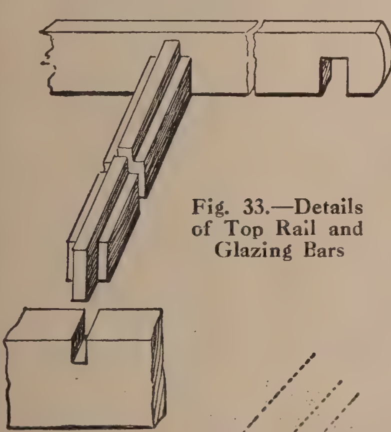


Fig. 33.—Details of Top Rail and Glazing Bars

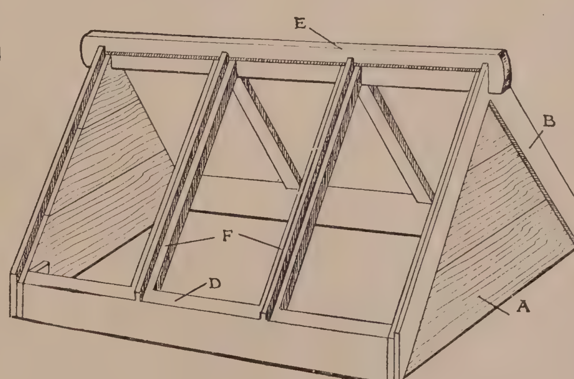


Fig. 30.—Framework of Hand Light

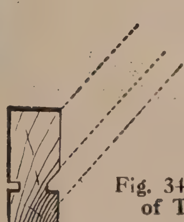


Fig. 34.—Section of Top Rail

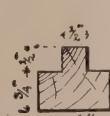


Fig. 32.—Section of Glazing Bar

The glazing bars F, two of which are fitted at each side of the light, are of a section similar to that shown by Fig. 32. These bars simply butt against the top rail, and are notched into the side rails, as shown in Fig. 33. Grooves are cut in the top rail in a line with the rebates in the glazing bars and ends to form a fixing for the glass. A square groove is first cut, and this is then bevelled at the bottom edge to correspond with the slope of the glazing bars and ends, as shown in Fig. 34.

The glass used in glazing the light should be 21 oz., sprigged and bedded in oil putty, care being taken to paint the rebates before glazing. An iron handle similar to that shown in Fig. 26 is screwed to the top rail, and will be found useful for moving the light. When complete the light should be painted with not less than two coats of good oil paint.

EASILY-MADE PROPAGATOR

Where a greenhouse or hotbed is not available, a propagator is very useful for raising plants and bringing them on as soon as possible. The one shown by Fig. 35 can easily be put together at quite a trivial cost. In appearance it resembles a miniature garden frame on legs, with a slanting glass roof, which can be raised or moved as required. It is heated by a paraffin-oil lamp, and is so constructed that no noxious fumes can reach the seedlings. The outside dimensions of the propagator are 2 ft. 7½ in. wide by 1 ft. 10½ in. deep, and it stands 3 ft. 1 in. high at the back and 2 ft. 8½ in. at the front.

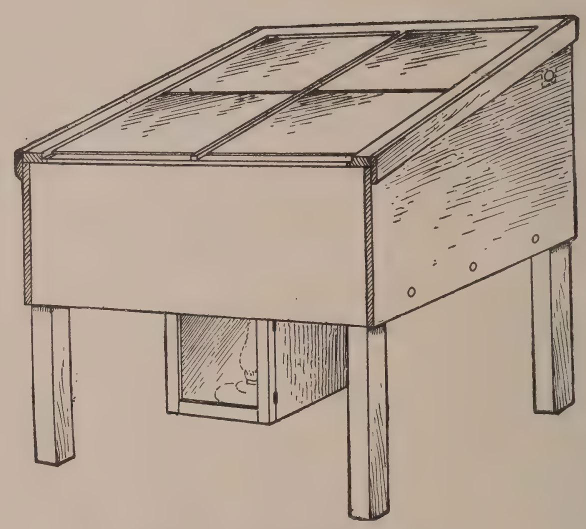


Fig. 35.—Easily-made Propagator

As will be seen on reference to the cross section (Fig. 36), the water tank, which measures 2 ft. 6 in. by 1 ft. 9 in. by 1½ in. deep, rests on the top of the legs, and thus gives the propagating chamber a depth of about 1 ft. 2 in. at the back and 10 in. at the front.

To begin the construction, first cut four legs from a length of 2-in. quartering, and square them off to each 1 ft. 8 in. long. These should be then connected at the top by rails 2 in. wide by 1 in. thick, which should be dovetail-keyed into the legs, as in Fig. 37. The rails should be

brought flush with the outside face of the legs, and the dovetails worked parallel on the front face and made only $\frac{7}{8}$ in. long into the thickness of the latter. The legs and framing, which should now resemble Fig. 38, are next covered in on the under-

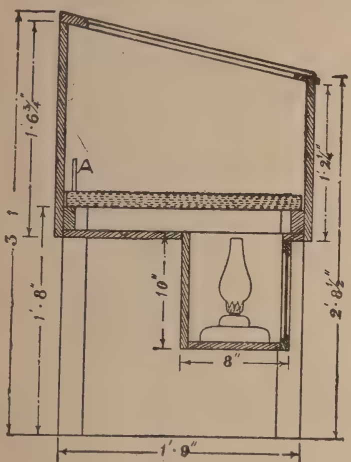


Fig. 36.—Cross Section of Propagator

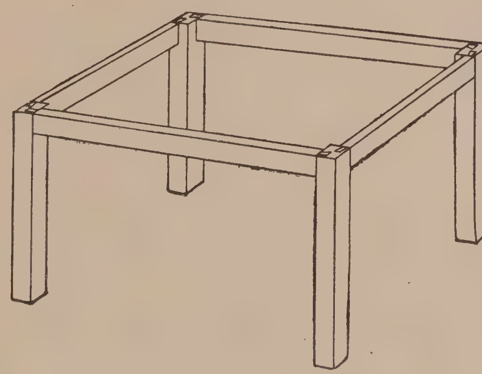


Fig. 38.—Legs and Framing

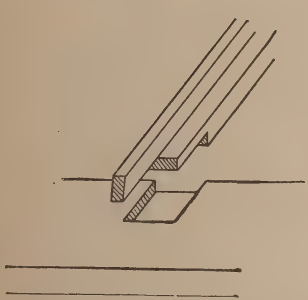


Fig. 41.—Joint of Centre and Bottom Rail

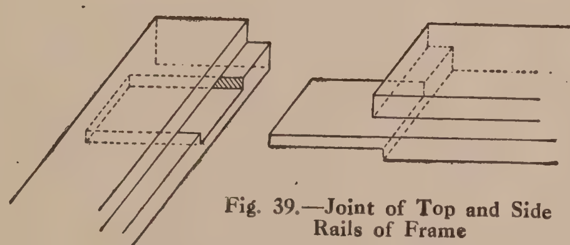


Fig. 39.—Joint of Top and Side Rails of Frame

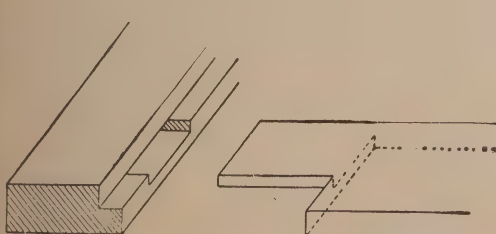


Fig. 40.—Joint of Bottom and Side Rails of Frame

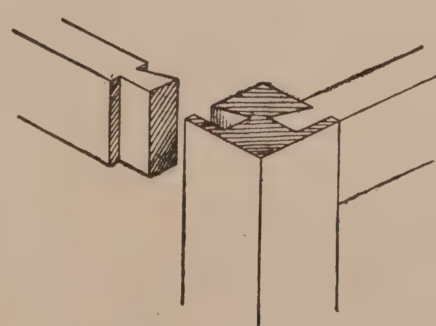


Fig. 37.—Method of Fixing Rails to Legs

side of the rails with $\frac{3}{4}$-in. grooved-and-tongued boarding, leaving an opening 8 in. square at the centre of the front for the reception of the lamp chamber. This should be made 10 in. high of the same thickness boarding, nailed together at the angles and all round at the top to the edge of the opening in the bottom of the propagator. A glass panelled door should be hinged at the side of the front of the lamp chamber for the purpose of attending to the lamp, and a few $\frac{3}{4}$-in. holes made in the sides to allow air to enter and the fumes to escape.

The sides of the propagator are next cut from $\frac{3}{4}$-in. grooved-and-tongued boarding, the front measuring 1 ft. $2\frac{1}{4}$ in. high and the back 1 ft. $6\frac{3}{4}$ in. These are nailed together at the corners, and also to the framework at the top of the legs. It is of great importance to have well-seasoned boarding, and to see that the tongues are not broken away in places, causing bad joints, or the heat will escape at any gaps and cause trouble with draught to young seedlings.

The glass-framed top is of 1-in. stuff, and the top and two side pieces should be planed to $2\frac{1}{2}$ in. wide, and rebated throughout their length to a depth of $\frac{1}{2}$ in. each way. The front piece need only be $\frac{1}{2}$ in. thick and $2\frac{1}{2}$ in. wide. The four pieces should now be mortised and tenoned together, the top into the two sides as in Fig. 39, and the bottom piece as in Fig. 40. A centre rail 1 in. square and rebated on each side should be tenoned into the top and let in the bottom as in Fig. 41, and when the joints are ready, glued up and wedged in tightly between two lengths of batten, so that the joints come up quite close. With the addition of a couple of runners nailed to the top of the sides, this will complete the woodwork of the propagator. The rebating should receive a coat of white-lead prior to bedding the glass in soft oil putty, or the latter will not stick properly, after which the whole should be painted with three coats of good oil colour to preserve the wood.

The tank to contain the water should be made of stout zinc well soldered together at the angles, and to prevent the top sagging in the centre, a few short pieces of zinc tubing should be soldered on the inside at intervals. A short length of tubing A (Fig. 36) should also be soldered at one of the sides, by which the tank may be emptied or filled. A good paraffin-oil lamp capable of holding sufficient oil to last at least a full day without requiring to be refilled will be needed to heat the tank, and the top of the glass chimney should be quite 2 in. or 3 in. clear of the bottom of the tank.

The best material with which to cover the top of the tank is undoubtedly cocoa-nut-fibre refuse; but if this is not procurable or is too expensive, fresh sawdust will answer the same purpose. Whichever is used, it is imperative that the material be kept thoroughly moist throughout the entire depth. A thermometer should be fixed to one of the sides of the propagating chamber, so that it can easily be seen from without, and for general purposes an even temperature of about 60° should be maintained. The lamp should be first turned up as for giving light, and when once the heat is diffused throughout the propagating material it should be turned low. The chamber will then keep up an even temperature and the lamp will burn all night and day without needing replenishing or altering.

Greenhouses

PORTABLE GREENHOUSE: TENANT'S FIXTURE

A special feature of the greenhouse shown by Fig. 1 is its portability. It is of simple construction, being formed of four principal parts, namely, top, side, and two ends, and these being connected together with screws, very little fixing to the wall is required. By this means the greenhouse would be a tenant's fixture, and, for removal, could be taken apart by undoing a few screws. Front and two end elevations are shown by Figs. 2, 3 and 4.

Good quality red deal will be the most suitable wood, and it will be more economical to buy it ready sawn to the following sizes: Bars for side, ends, and roof, 2 in. by 1 in., 120 ft. run; stiles, rails, etc., for sides and ends, 3 in. by 2 in. 120 ft. run; stiles and rails for roof and

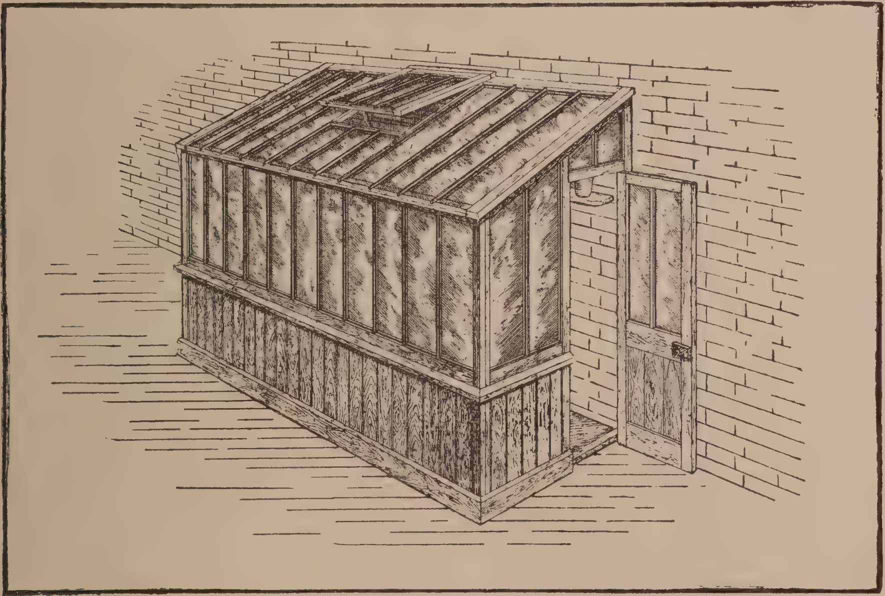


Fig. 1.—Portable Greenhouse

middle rail of side and ends, $4\frac{1}{2}$ in. by 2 in., 50 ft. run; bottom rail of roof, $4\frac{1}{2}$ in. by $1\frac{1}{4}$ in., 13 ft. run; ventilating skylight, 3 in. by $1\frac{1}{2}$ in., 14 ft. run; hinged sash in end, 2 in. by 2 in., 14 ft. run; matchboarding for lower part of framing, including plinth, $\frac{7}{8}$ in. by $6\frac{1}{2}$ in., 130 ft. run; middle and bottom rail for door, 7 in. by 2 in., 5 ft. run; weathering strip, and stout bars in end and roof, $1\frac{1}{2}$ in. by 2 in., 50 ft. run. The foregoing sizes are for the wood in the rough, the dimensions marked on the illustrations being those of the wood when planed. To prevent waste, care must be taken to purchase such lengths of wood as will cut up to the best advantage.

Saw the wood off to lengths; all vertical parts such as stiles should be cut off 2 in. longer than required; for the rail-pieces having tenons allow about $\frac{1}{2}$ in. longer at each end. All the pieces should be planed true on one side, then an edge planed at right angles, after which they should be gauged, and planed to the thickness and breadth indicated in the illustrations. It is advisable to set out and complete one piece before attempting the second, so as to avoid mistakes through the pieces becoming mixed.

The principal parts lettered in Figs. 5, 6, and 7 are as follows: A, bottom rail; B, middle rail; C, top rail; D, bottom rail of roof; E, trimming bar; F, top rail of roof; G, wall-piece; H, top rail of ventilating skylight; M, fillet to hinge same to; J, bottom rail of skylight; K, plinth; L, weathering strip or sill; N, stile of side; O, P, and T, stiles of end; R and S, stiles of door; U, matchboarding; V, stop round door opening; W, bar.

The setting-out and subsequent operations for the side will now be described. The two angle stiles should be placed

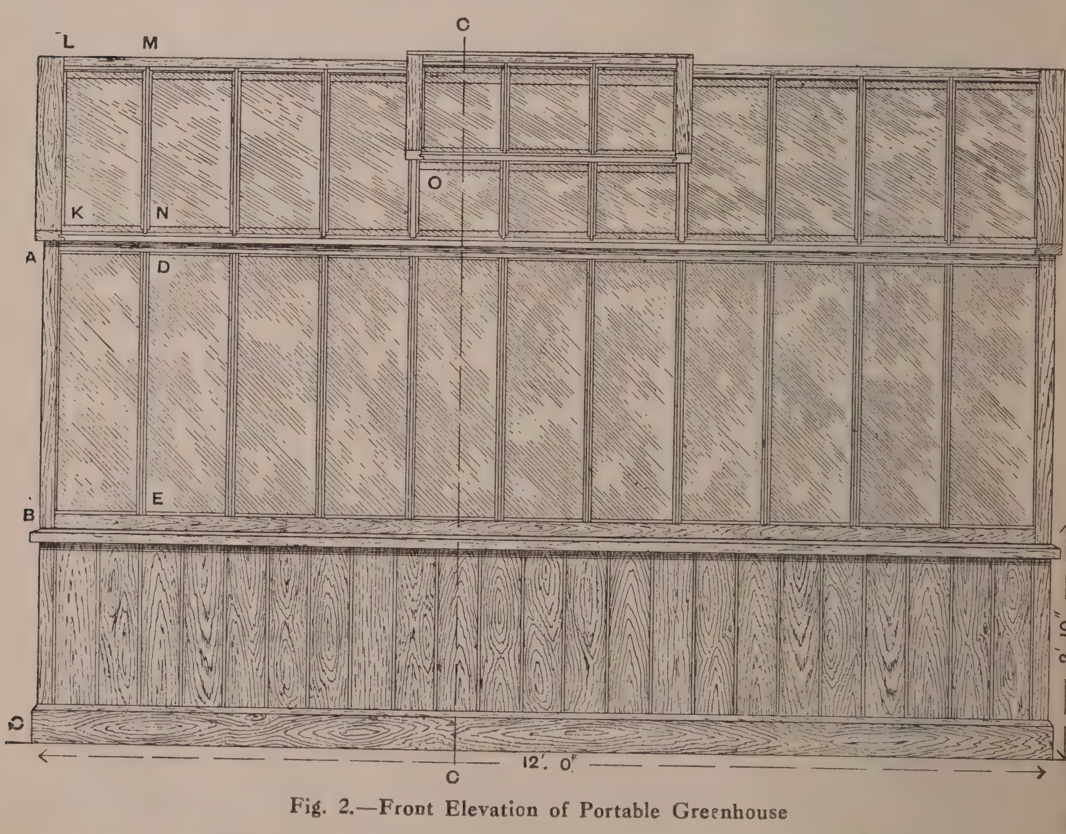


Fig. 2.—Front Elevation of Portable Greenhouse

together in pairs, the positions for mortises being shown in Figs. 8 and 9, and a halved joint (Fig. 10) should be marked across the edges; as the mortises are to be made right through, the lines must be continued to the opposite edges. The top, middle, and bottom rails can next be placed together, and marked out for shoulders at each end (*see* Figs. 8, 9, and 10). They should also be set out for the mortises for the bars (Figs. 11 and 12). By referring to Figs. 8 and 9, it will be seen that the outer shoulder has to fit to the rebate, and therefore must be set out to the depth of the rebate longer than the inner one. The mortise gauge should now be set to suit the chisel that is to be used (one about $\frac{5}{8}$ in. will be the most suitable), then gauge the pieces for the mortises and tenons. Next make the mortises in the stiles and rails; in the former they go through, and in the latter they should be about $1\frac{1}{4}$ in. deep, as indicated in Figs. 11 and 12. The tenons can now be cut; not the shoulders. The bars should next be set out and gauged, and the tenons cut. Each piece should now be gauged for the rebates. The rebating can be done with a side fillister; but if this tool is not available, a rebate plane can be very easily adapted for the purpose. Three pieces of wood are screwed to the plane; one to only allow it to work a fixed distance "on," and two other pieces to prevent it going below the desired depth. Care must be taken to keep the iron projecting a little beyond the side of the plane, in order to produce clean rebates.

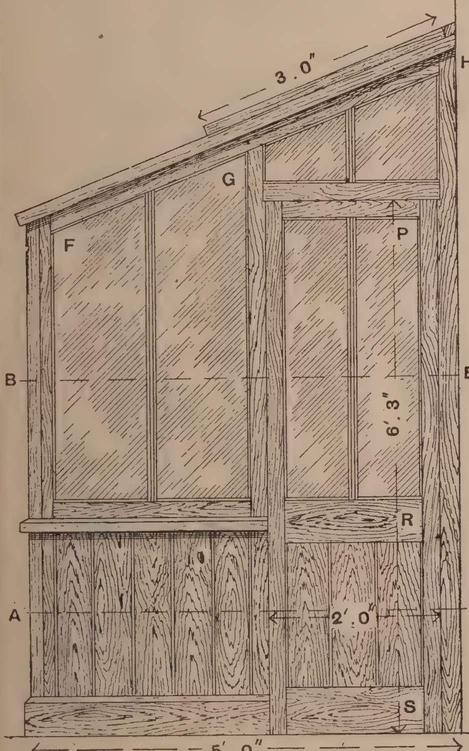


Fig. 3.—Elevation of Door End of Portable Greenhouse

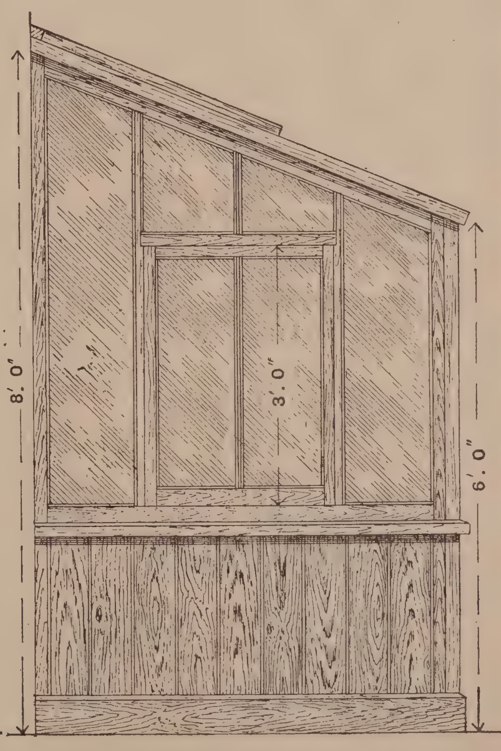


Fig. 4.—End Elevation of Portable Greenhouse

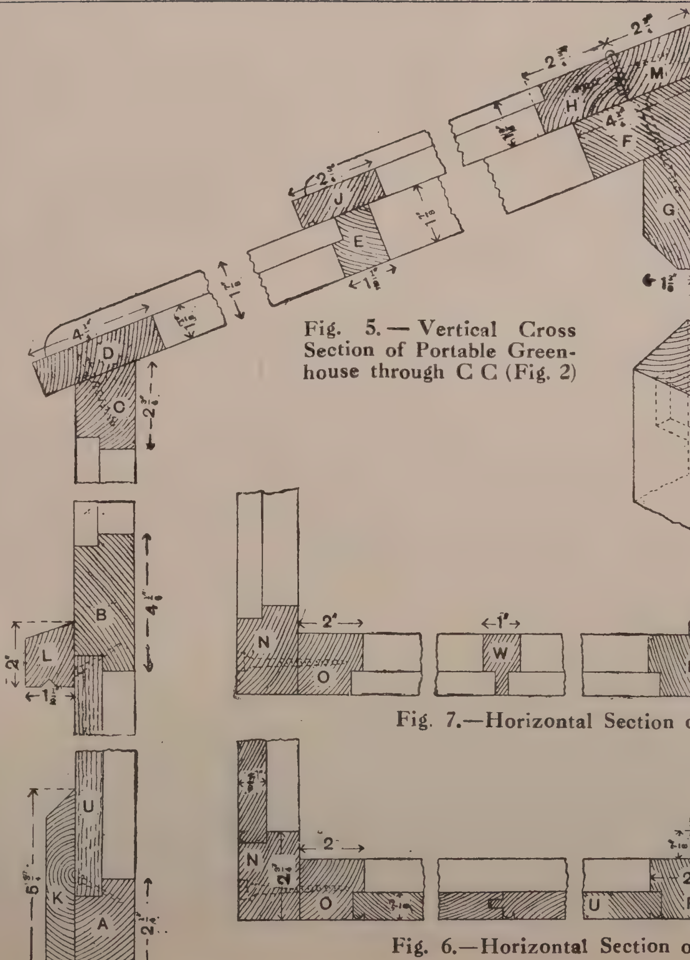


Fig. 5. — Vertical Cross Section of Portable Greenhouse through C C (Fig. 2)

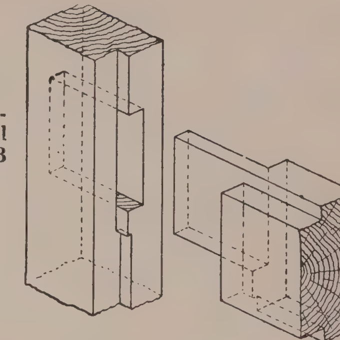


Fig. 9.—Joint between Middle Rail and Upright at B (Fig. 2)

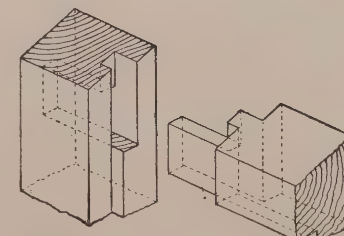


Fig. 8.—Joint between Top Rail and Upright at A (Fig. 2)

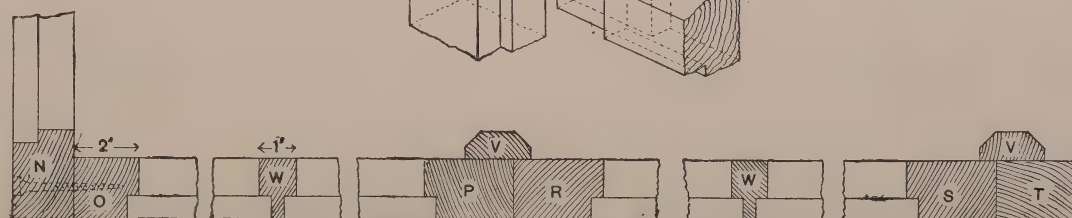


Fig. 7.—Horizontal Section of Portable Greenhouse through B B (Fig 3)

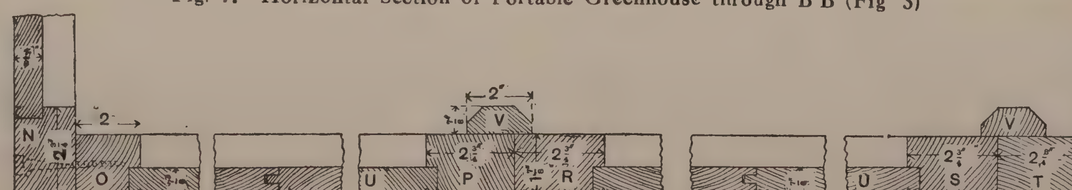


Fig. 6.—Horizontal Section of Portable Greenhouse through A A (Fig. 3)

The shoulders of the tenons can now be cut. The tenons of the top and middle rails must be reduced to the shape shown in Figs. 8 and 9, forming a haunch. The under edge of the middle rail and the top edge of the bottom rail require to be rebated for boarding (*see* Figs. 5, 10, and 12). Now plane the upper edge of the top rail to the angle shown at Fig. 5. The rebate of the lower part of the stiles must be made deeper, so as to receive the edge of the board (*see* Fig. 5). Each tenon must now be fitted in its respective mortise, after which the whole should be put together and any necessary easing done. Then take two pieces, paint the joints, and put together. The tenons of the top and middle rails must next be

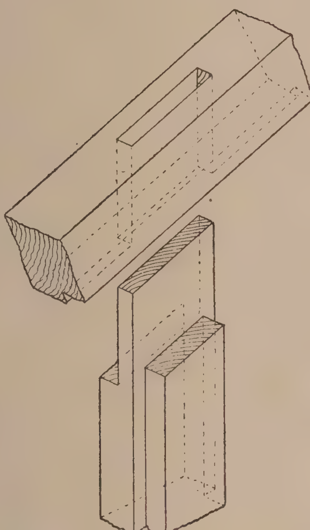


Fig. 14.—Joint between Door Post and Top Sloping Rail at G (Fig. 3)

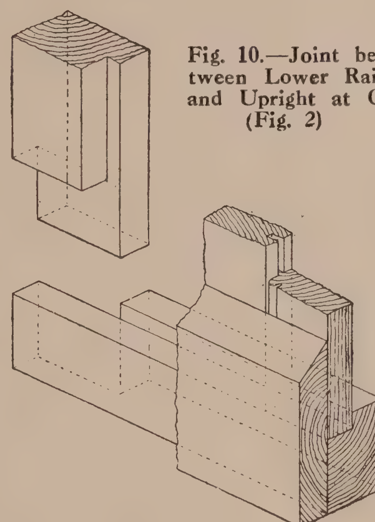


Fig. 10.—Joint between Lower Rail and Upright at C (Fig. 2)

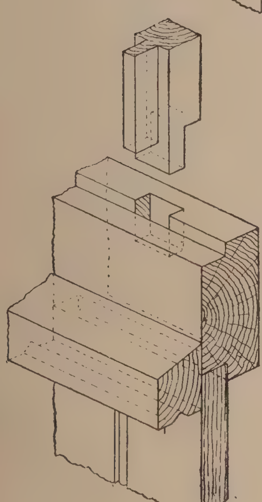


Fig. 12.—Joint between Glazing Bar and Middle Rail at E (Fig. 2)

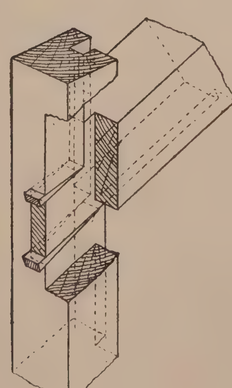


Fig. 13.—Joint between Upright and Top Sloping Rail at F (Fig. 3)

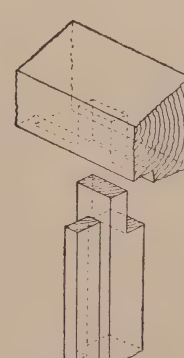


Fig. 11.—Joint between Glazing Bar and Top Rail at D (Fig. 2)

wedged in the mortises, as indicated at Fig. 13. The bottom rail and stiles can be connected with two or three screws. Any unevenness between the surfaces of the stiles and top and middle rails should be planed away. It is important to keep the frame square until the boarding is fixed in the lower part; that is, the stiles and rails must be held at right angles to each other. This can be done by temporarily nailing two strips of wood across the top angles. The matchboarding for the lower part can now be cut off to lengths and secured to the middle and bottom rails with 2-in. nails driven in obliquely, as indicated in Fig. 5. The top of the stiles should be sawn and planed level with the top of the rails, and the ends of the tenons and wedges planed flush to the edges of the stiles.

Next prepare a board long enough to form the plinth (*see* K, Fig. 5), carefully mitre the ends, and secure by nailing to the boards and bottom rail. The weathering strip, or sham sill, L (Fig. 5) should be planed to the form shown; the **V**-groove can be made with the rebate plane. The ends of the sill should now be mitred; then nail the sill to its position as shown Secure the bars

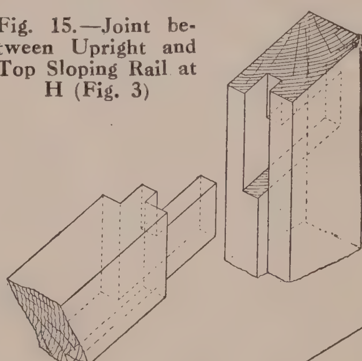


Fig. 15.—Joint between Upright and Top Sloping Rail at H (Fig. 3)

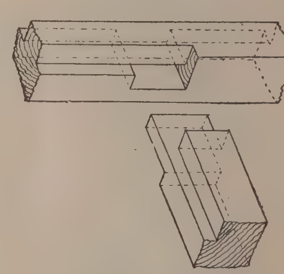
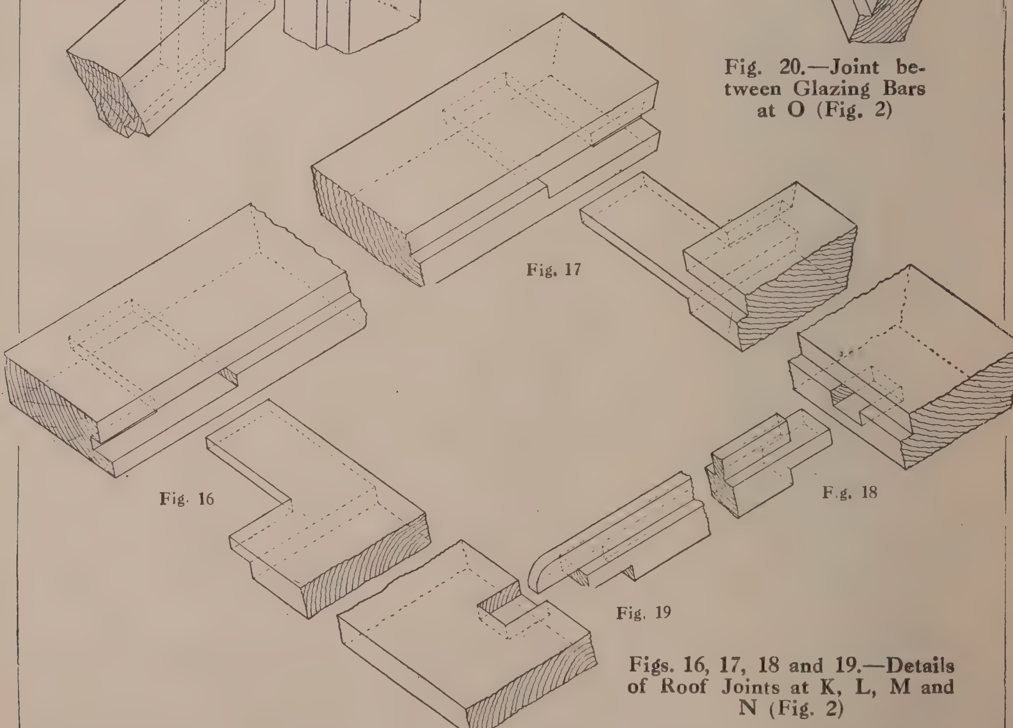


Fig. 20.—Joint between Glazing Bars at O (Fig. 2)



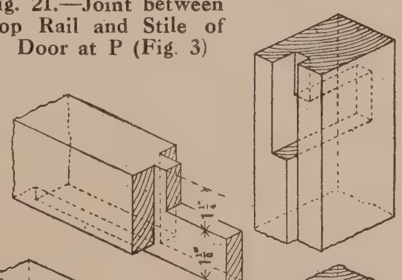
Figs. 16, 17, 18 and 19.—Details of Roof Joints at K, L, M and N (Fig. 2)

to the top and middle rails with a small nail.

The lower parts of the ends are prepared in a similar way to that described for the side. But two points that must be kept in view are, that the mitre of the sill piece and the plinth must be made to project beyond the edges of the stiles of ends, a distance equal to the thickness of the stiles of the side framing (*see* Figs. 3 and 4). It will be found easier to make the joints for the lower part and fit them together first. The top rail can then be placed in position, and the shoulders marked on it at each end, and also the position of the mortises in the stiles can be determined, after which the pieces may be gauged and the mortises and tenons made; the form of these is shown in Figs. 13, 14, and 15. The mortises for the bars in the top rail, also those for the pieces forming the top of the doorway and the hanging sash, should be set out and made. The ends can now be put together, and each bar laid on and marked for shoulders, then gauged; the tenons and shoulders can then be cut, and the bars fitted into their respective positions. The method of completing each end will be almost exactly the same as described for the side. A good plan is to procure a piece of oak about 2 in. square for a threshold, and to connect the stiles that form the doorway, as shown in Fig. 1.

The making of the roof and skylight should present little difficulty. The wood for the bottom rail should be planed up to dimensions, noting that the thickness of this is less than the stiles by the amount of the rebate. The several pieces should be set out for the joints, etc., which are shown by Figs. 16, 17, and 18, the one for connecting the stiles to the bottom rail requiring special notice. The form of joint between the bars and the bottom rail is shown by Fig. 19. By referring to Fig. 2 it will be seen that the bars supporting the ventilating skylight require to be rebated their whole length on one side, and only as far as the trimming piece on the other. It should also be noted that they are stouter than the other bars, and it will be as well to let their tenons pass through the top rail. The joint connecting the bars and the trimming pieces is shown by Fig. 20.

Fig. 21.—Joint between Top Rail and Stile of Door at P (Fig. 3)



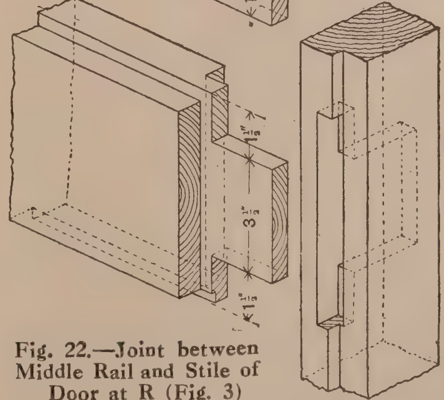


Fig. 22.—Joint between Middle Rail and Stile of Door at R (Fig. 3)

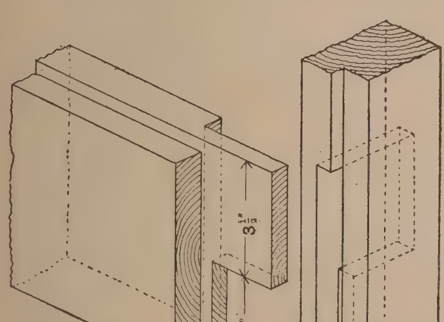


Fig. 23.—Joint between Lower Rail and Stile of Door at S (Fig. 3)

The tenons of the bars should be fixed to the top and bottom rails with a small nail, and the whole completed in a manner similar to that described for the other parts. The joints of the door are shown by Figs. 21, 22, and 23.

The method of fixing will now be described. The ground where the ends and a side are to stand should be levelled, and very suitable foundation would be formed by a course of bricks. One end and the side should be placed in position, and temporarily stayed until screwed together; the other end should be fixed to the side in the same manner. The wall piece G (Fig. 5) should be prepared and cut off to the exact length. This should next be placed in position and firmly secured to the wall with 4-in. nails driven into the brickwork. The roof can now be lifted on and secured to the wall piece, ends, and side with $3\frac{1}{2}$-in. screws, as indicated in Fig. 5. The stiles abutting to the walls should be secured by two or three holdfasts. Then plane the edges of the door and sash to fit into their respective openings and hinge them, and also the skylight on the top. A chamfered fillet, as shown in section at V (Figs. 6 and 7), should be prepared and fixed round inside the door opening and window in the opposite end.

The greenhouse will now be ready for a first coat of paint, after which it should be glazed and finally finished with two more coats of paint of any colour desired.

SMALL SPAN-ROOF GREENHOUSE

The matter of keeping the cost as low as possible has been consistently borne in mind when designing the span-roof greenhouses shown in side and end elevations by Figs. 24, 25, and 26, and to further this object in the actual construction it is not advised that the timber should be purchased in so many pieces cut to the lengths required, or it will cost more; but rather that it should be bought in bulk, the worker cutting it up himself. The quantities required, with the various sizes and sections are given later.

The greenhouse is 12 ft. long by 7 ft. wide, the height being 5 ft. to the eaves. The roof is of square pitch, that is, the rafters form a right angle at the top, and the whole structure stands on a foundation consisting of a single row of bricks as shown. The lower portion is boarded with 1-in. tongued-and-grooved boards, the upper part and the roof being glazed. The door is placed in the middle of one end of the house, thus leaving room for a stage down each side. Ventilation is provided for by the two ventilators at one side of the roof, and one at the other, thus forming a through current of air, which can be regulated as desired.

The necessary setting out and framing together is very simple. Figs. 27 and 28 show the framing of the door end and one side respectively. In these latter illustrations the posts A are the same. The corner posts must be mortised as in Fig. 29 to take the sills, the middle rails, and the top rails or plates. The whole of the mortises must be kept back from the face sides (that is the outsides) the thickness of the boarding to be used in the lower part, which will be $\frac{7}{8}$ in. This will facilitate the making of the rebates to take the glass and the boarding, and also simplify the tenons on the various rails, etc., which have to fit to the posts. The intermediate posts in the sides and ends will be mortised to take the middle rails, as shown in Fig. 30, these mortises passing straight through. They will also be tenoned to fit into the top rails (plates), and cut as shown at the bottom to fit the sills. The reason of this latter cut, instead of an ordinary tenon, will be given later. The two door posts will be similar to the last mentioned, with the exception that instead of the tenon to fit into the top rails, mortises must be made instead, as shown in Fig. 31. These mortises must not be allowed to pass through the wood, or it will show in the doorway. Other similar mortises must be made higher up and on the opposite sides to take the door head, and the posts should be left to run up so as to cut off afterwards to fit the rafters when these are fitted and fixed.

The sills will need cutting, as in Fig. 32,

being kept less in width to allow the board to run down beyond them. The mortises take the form of slots, which accounts for the shape of the tenon at the bottom of the intermediate posts (Fig. 30). The tenons at the end of the sills, which fit into the corner posts, must be " barefaced "; that is, with a shoulder on the inside only, as shown on the left in Fig. 32. The top rails will be tenoned as in Fig. 33, to fit the corner posts; also mortised to take the intermediate posts. These mortises should not go through the wood. The rail is shown wrong way up in the illustration, so as to show the mortises. The outside upper corner of them stronger, they are each made nearly long enough to reach through the post, and each halved on to its fellow. Thus the rails will not only be pinned to the post, but will also be pinned together through the halving. The corner posts will need rebating to take the glass and boards at each side on the outside corners; the intermediate posts will need rebating in the same way at each of the outer corners; also the top rails on the underside, and the middle rails both on the under and the upper sides. The rebates in all cases should be $\frac{3}{8}$ in. deep, and reach to the mortise or tenon, as the case may be. Thus Fig. 33 is shown ready

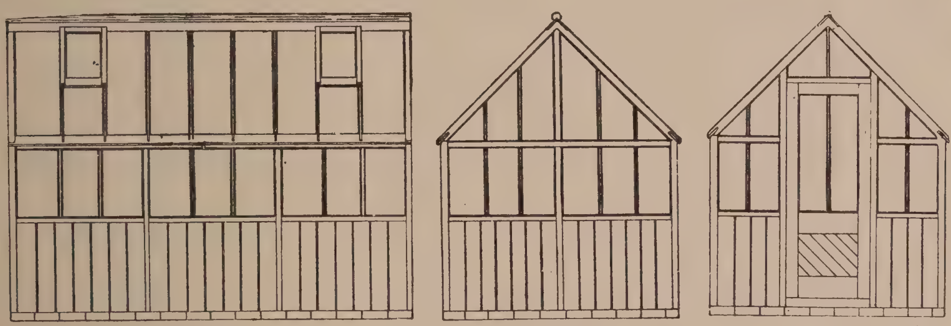


Fig. 24. Fig. 25. Fig. 26.

Figs. 24, 25 and 26.—Side Elevation, Elevation of Closed End and Elevation of Door End of Span-roof Greenhouse

these rails must be chamfered off to an angle of 45°, as shown in Fig. 28, to form a bed for the eaves board, and when the framing is put together the chamfers will be continued on the ends of the posts as shown. Fig. 34 shows the top rail for the end opposite the door (Fig. 25). The ends of the tenons are shown mitred so as to fit up to the tenons of the side rails in the corner posts, thus giving more hold for the pins when fixing together. The mortise for the middle post must, in this case, pass through the wood to take the continuation of the post. In the middle side rails (*see* Fig. 25) the tenons would be very short where they come to the intermediate posts, if cut in the ordinary way, therefore, to make for rebating, and Figs. 34 and 35 are shown with one rebate made. The door posts will need rebating as above at one side; but the door side will either need a deeper and wider rebate to take the door, or slips may be nailed on to answer the same purpose; probably the latter will be found the better way. In all cases where a tenon comes to a mortise in a post or other part that has to be rebated, the outer shoulder must be left longer to fit into the rebate. Fig. 36 is a section of one side of the greenhouse.

When all the parts are cut correctly, the whole frame may be put together, carefully painting each mortise and tenon as it is fitted; also the pins as they are driven in. The frame will then be ready

for the roof, a section of which is shown by Fig. 37. Fig. 38 is an enlarged section at the eaves.

The outside rafters must be cut as in Fig. 39 and the intermediate ones as in Fig. 40; and the roof being of square outside rafters may be tenoned together; or, if preferred, they can be halved, and fixed with screws; or they may be mitred. The intermediate rafters will, as a matter of course, be mitred, and no ridge board is necessary. At the upper

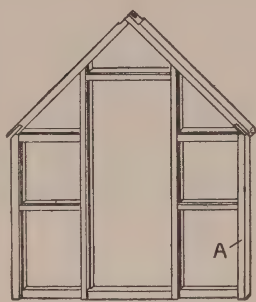


Fig. 27.—Framing of Door End of Span-roof Greenhouse

Fig. 28.—Framing of Side of Span-roof Greenhouse

Fig. 36.—Section of Side of Span-roof Greenhouse

Fig. 29.—Corner Post

Fig. 30.—Intermediate Post

Fig. 31.—Door Post

Fig. 32.—Sill

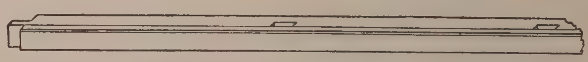


Fig. 33.—Top Rail (Side) Mortised and Tenoned (Reverse Way Up)

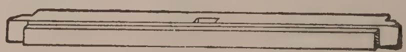


Fig. 34.—Top Rail (End) Mortised and Tenoned

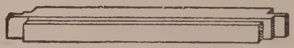


Fig. 35.—Middle Rail, Tenoned

pitch, it follows that the angle at the bottom will be one of 45°. The point at A must come to the edge of the chamfer on the top rail, so that the plain surface B and the chamfer are continuous when the rafters are fixed, and form a bed for the eaveboard C. At the upper end the ends the tongues of the rafters must be cut away down to within about $\frac{3}{16}$ in. of the rebate, to take the boards D, which will fix to each pair of rafters on both sides of the roof, and the glass will fit up under them, as in Fig. 41. These roof boards may be anything from 3 in. to

5 in. wide by $\frac{3}{4}$ in. thick. They are nailed one on the other at the apex of the roof, the ridge roll E covering the joint. In fixing the boards, take care that the rafters are kept the correct distance between.

The two ventilators take the form of in a small house like the one being described, the top rail can be fitted and hinged to the ridge roll. The opening of the ventilators is done by means of a curved iron bar fixed to the bottom rail of the ventilator and a cord passing over a pulley fixed in the cross trimmer

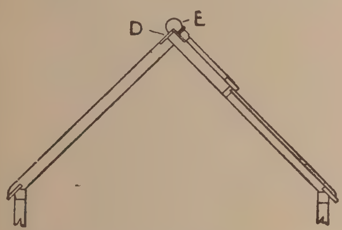


Fig. 37.—Section of Roof of Span-roof Greenhouse

Fig. 38.—Enlarged Section of Eaves

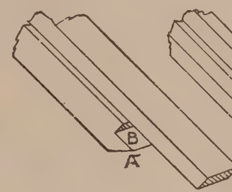


Fig. 39.—Foot of Outside Rafter

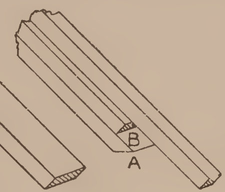


Fig. 40.—Foot of Intermediate Rafter


Fig. 41.—Section of Ridge Board Rafter and Glass

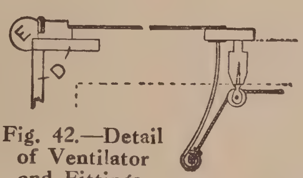


Fig. 42.—Detail of Ventilator and Fittings

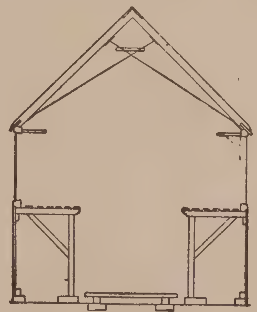


Fig. 45.—Section of House showing Fittings

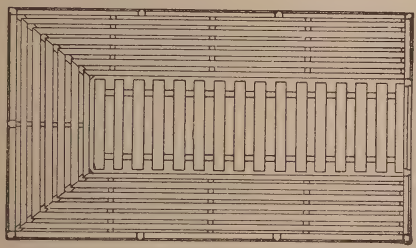


Fig. 44.—Plan of Staging and Floor


Fig. 43.—Plan of One Side of Roof

small sashes, made so as to cover one pair of rafters in width, and to reach about halfway between the ridge and the eaves in the length. A piece of rafter material is fixed between the pair of rafters, in the correct position for the bottom rail of the sash to rest on. When closed, and between the rafters. A section of the whole arrangement is shown by Fig. 42. The plan of one side of the roof (Fig. 43) shows the position of the two ventilators on that side; the dotted lines also show the position of the single ventilator on the opposite side. The bars in the sides

and ends of the greenhouse, apart from the actual framing, may be cut to fit tightly and fixed with brads; or they may be tenoned into the middle rail and bradded to the top rail, if preferred. The fixing of the boarding round the greenhouse will present no difficulty, and the door can be simply framed up with mortise-and-tenon joints or halving joints. The door will be fixed with butt hinges, and should be fitted with a lock and key.

A plan of the inside fittings is shown by Fig. 44. The staging along each side is 2 ft. wide, and that across the end is 6 in. wider. It consists of battens 2 in. wide by 1 in. thick fixed to the bearers, as shown in the section (Fig. 45), with a space of about 1 in. between. The ends of the bearers which come to the outside of the greenhouse rest on fillets screwed to the outer boarding as shown, the inner edge of the staging being supported by the braced legs. These latter should stand on a brick laid in the ground or firmly on it, and should be painted on the end grain before they are fixed. The floor, as shown, may be dispensed with if preferred; but the greenhouse will be found much more comfortable with it. It consists of two pieces of scantling 2 in. square resting on bricks at intervals in their length, the floor proper being slats 3 in. or 4 in. wide, spaced out as shown. The whole should be kept down in width sufficiently to allow of the complete floor being turned up and taken out through the door when required. Shelves may be fixed along the top rail, supported by brackets, as shown in Fig. 45, and another one may be fixed in the top part of the roof. Solid shelves are shown as being more convenient for fixing; but if formed of laths in the same way as the staging, they will last longer. Iron tie rods, as shown in Fig. 45, should be fixed across the house in the middle lengthwise.

In conclusion, a specification of the materials required to build the greenhouse is here given, the various sections being shown by Figs. 46 to 56. Top rail (Fig. 46), 24 ft. required; corner posts and end rafters (Fig. 47), 50 ft.; sills (Fig. 48), 40 ft.; intermediate posts and middle rails (Fig. 49), 70 ft.; intermediate rafter for glass 15 in. wide (Fig. 50), 120 ft.; stiles and top rails of ventilators (Fig. 51), 24 ft.; ridge roll (Fig. 52), 12 ft.; eave and ridge boards (Fig. 53), 52 ft.; slats and bearers for stage and floor (Fig. 54), 400 ft. for A and 100 ft. for B; door post (stop nailed on) (Fig. 55), 14 ft.; door post solid (alternative) (Fig. 56), 14 ft.; $1\frac{1}{4}$ squares of 1-in. tongued-and-grooved boarding; 14 ft. of 9-in. by $1\frac{1}{2}$-in. for the door; 60 ft. of sash bar (as Fig. 50, but smaller); 300 ft. of horticultural glass; putty, paint, nails, screws, etc.

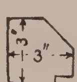


Fig. 46.—Section of Top Rail

Fig. 47.—Section of Corner Posts and Outside Rafters

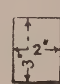


Fig. 48.—Section of Sills

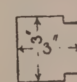


Fig. 49.—Section of Middle Rails, Intermediate Posts, etc.

Fig. 50.—Section of Rafter and Sash Bar

Fig. 51.—Section of Framing for Ventilators

Fig. 52.—Section of Ridge Roll

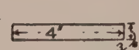


Fig. 53.—Section of Eaves and Ridge Board

Fig. 54.—Section of Slats and Stage Bearers

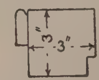


Fig. 55.—Section of Door Post with Stop Attached

Fig. 56.—Section of Solid Door Post

Tents

PORTABLE SUMMERHOUSE TENT

A STRUCTURE having the advantages of a summerhouse combined with the portable character of a tent, capable of being taken from one house to another, or of being packed away in a small space, has several points in its favour. Such a shelter provides a very fair garden room for rest cures or other purposes.

A perspective sketch of the tent is shown by Fig. 1, and another sketch (Fig. 2) shows the construction generally. It will be seen that it is composed of a light wooden framework screwed together, or preferably put together with one small galvanised thumbscrew and nut through each joint. Each end is supported by a framework of the dimensions shown, consisting of two 3-in. by 2-in. rafters and a 3-in. by 2-in. horizontal sill with shaped ends. These are connected by two sloping standards, also 3 in. by 2 in., fixed on the inside, while on the outer side are screwed two upright planks, 5 in. by 1 in., to stiffen the whole. Side and end elevations are given by Figs. 3 and 4. At the apex the rafters are held together by a small iron plate, screwed on as shown in the isometric drawing, Fig. 5, of one end of the ridge, and are notched out to take the end of a 4-in. by $1\frac{1}{2}$-in. ridge piece, which is also notched out as shown, so as to fit over the rafters.

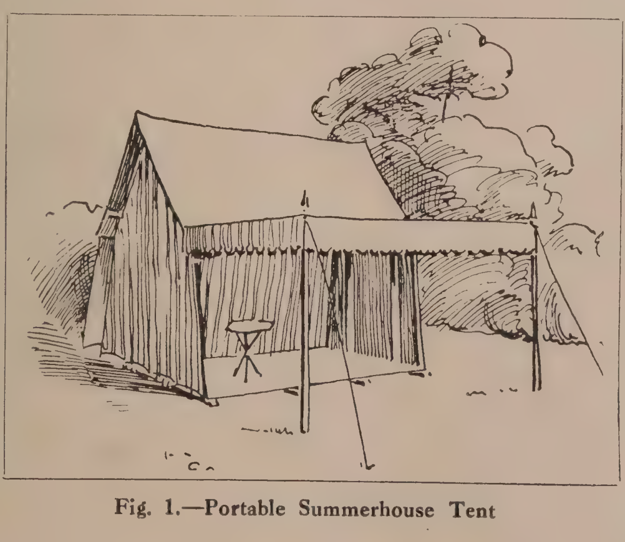


Fig. 1.—Portable Summerhouse Tent

The ridge is of such a length as to keep the standards 10 ft. apart and to overhang about 7 in. It has a wedge-shaped fillet 12 in. long fixed at each end for appearance. At the lower ends of the rafters 3-in. by 2-in. pieces of the same length as the ridge are screwed, and these complete the framework, which should be found to be fairly rigid. Two lengths

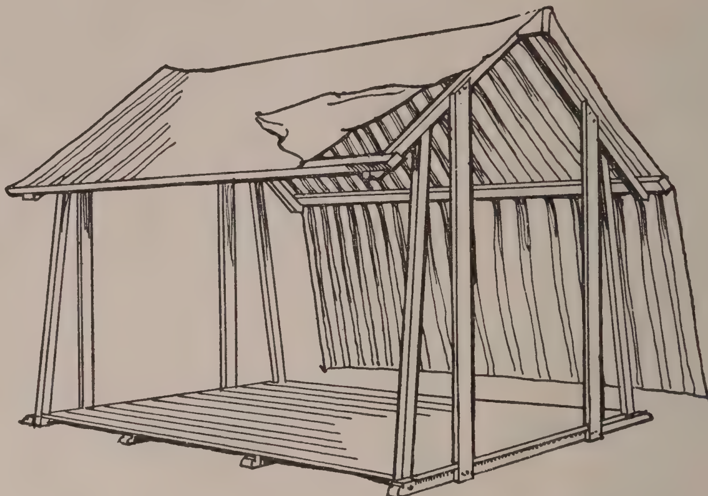


Fig. 2.—Portable Summerhouse Tent showing Construction of Framework

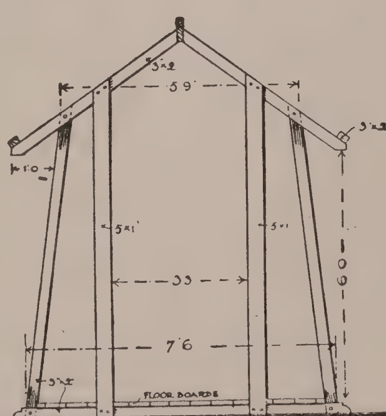


Fig. 3.

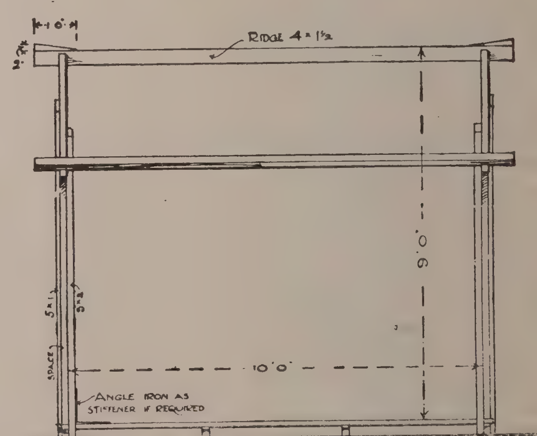


Fig. 4.

Figs. 3 and 4.—End and Side Elevations of Framework of Tent

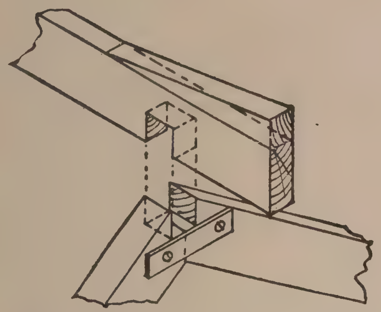


Fig. 5.—Joints at Apex of Rafters of Summerhouse Tent

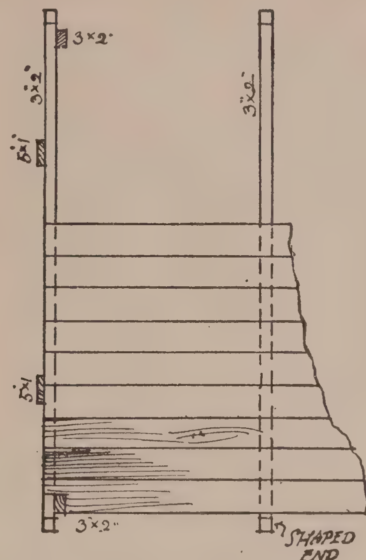


Fig. 6.—Plan of One End of Summerhouse Tent

similar to the sill pieces can be laid on the ground between the ends, and a light boarded floor laid across them, as partly shown on the plan (Fig. 6). These boards need not all be fixed, for if a light fillet be screwed across them at each end this will keep the whole in position. Should there be any slight lack of steadiness when completed, a plain flat angle bracket can be fixed at each end, as shown in the front view.

The drawings fully explain the nature of the summerhouse, and also show how it is intended to be covered with strong striped blind-canvas fixed to the woodwork with rings and hooks. One broad piece will be tied to pegs in the ground at the back, and come up over the ridge and down to the front as shown, and side pieces the shape of the ends will need to be fitted in position. At this stage it may be left, or the awning may be continued on cords and two upright poles to shade a distance of 6 ft. or more in front of the summerhouse, as suggested by the smaller of the perspective views.

GARDEN TENT WITH EXTENDING CANOPY

A garden tent of simple construction and which may be made at a small cost is shown by Fig. 7.

The framework, as will be seen on referring to Fig. 8, consists of a number of upright rods, which are connected by other horizontal rods, while the roof is formed with four rods, which are connected in the centre. The tent may be made to any size which will best meet individual requirements, although a convenient size would be a body 8 ft. square by 6 ft. high, with an extending canopy 8 ft. long, the roof of the body having a rise of 1 ft. 6 in. in the centre. It will be found advisable to make the rods of ash, each being 1¼ in. in diameter. The upright rods are cut to a length of 6 ft., and a metal ferrule is fitted at each end to prevent splitting. Small iron spills are fitted at each end of the upright rods, as shown in Figs. 9 and 10. These may be formed from long wire nails by simply removing the heads. The spills are driven into the ends of the rods, those at the top ends projecting about 2 in. and those at the bottom ends about 3 in. The horizontal rods which connect the upright rods are next prepared. Metal ferrules are fitted to the ends, and an iron screw-eye, similar to that shown by Fig. 11, is screwed into each end. The horizontal

rods are fitted to the upright rods by means of the screw-eyes, which fit over the projecting spills on the upright rods as shown in Fig. 9.

The roof rods are cut long enough to give the required rise in the centre, and metal ferrules are fitted at the ends. Screw-eyes are fitted at each end of the roof rods, with one exception, in which case a spill and fly-nut is fitted in place of the screw-eye. The spill and fly-nut is shown by Fig. 12, and it provides a means of connecting the roof rods in the centre. The screwed spill is $\frac{5}{16}$ in. in diameter, and is fitted with a fly-nut; a taper spill is also provided at the top, and this is driven into the end of the rod. Six guy-ropes are required for keeping the tent rigid, and one of these is fitted to each of the upright rods. A metal eye-piece is spliced, or securely tied, to the top end of each rope, as shown in Fig. 13. A suitable peg is shown by Fig. 14; each peg should be about 8 in. long by $1\frac{1}{4}$ in. wide by $\frac{3}{4}$ in. thick, and shaped as shown. The toggles (Fig. 15), by means of which the guy-ropes are tightened, should be about 4 in. long by $1\frac{1}{4}$ in. wide by $\frac{3}{4}$ in. thick. They are shaped as shown, and holes are provided at each end through which the ropes pass.

A striped tent cloth would be very serviceable for the covering. The sides and back should be separate from the roof covering, and the roof is fitted with a valance about 4 in. deep. The material is cut to shape, and the various portions are strongly sewn together. The covering is held in position by small looped tapes which are sewn at intervals round the edges, the tapes being threaded over the rods. Small turned wood caps, similar to that shown by Fig. 16, may be fitted to the top ends of the upright rods to give a finished effect. The caps fit over the metal spills, and they should be placed in position after the guy-ropes are fixed.

Brass curtain-rod ends, which may be obtained with a screwed shank, can be used as a substitute, and in this case the spills would not be required.

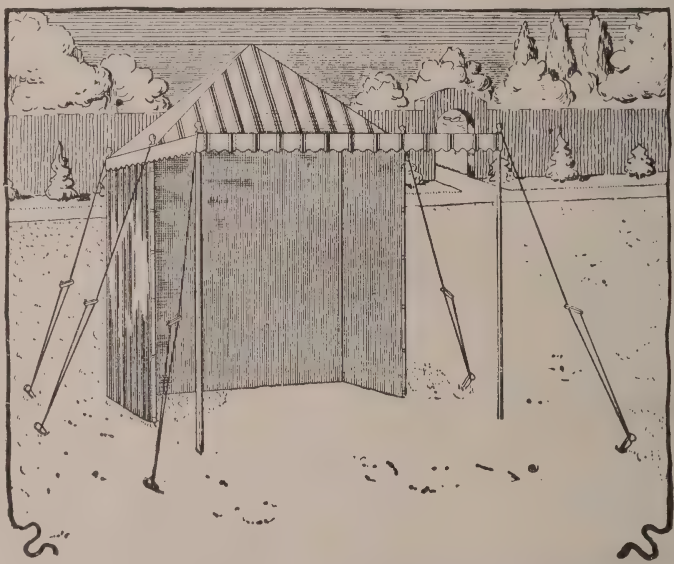


Fig. 7.—Garden Tent with Extending Canopy

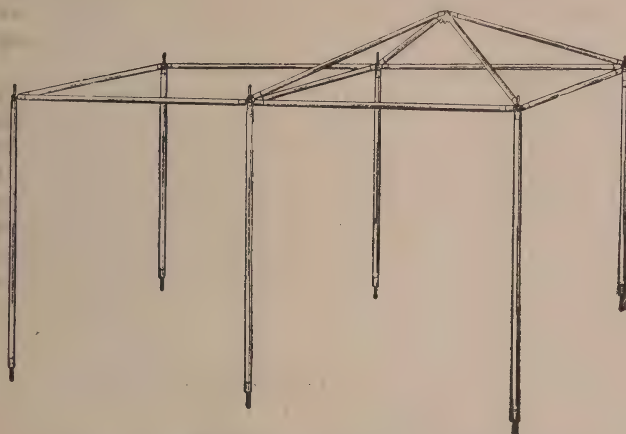


Fig. 8.—Framework of Tent with Extending Canopy

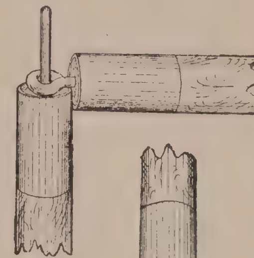


Fig. 9.

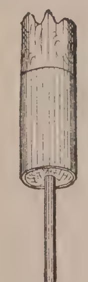


Fig. 10.

Figs. 9 and 10.—Top and Bottom of Uprights

Fig. 11.—Screw-eye

Fig. 14.—Ground Peg

Fig. 13.—Top End of Guy Rope

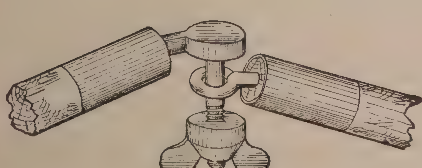


Fig. 12.—Connection for Roof Rods

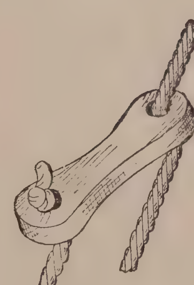


Fig. 15.—Toggle

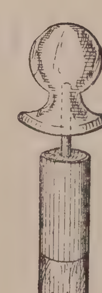


Fig. 16.—Turned Cap

PORTABLE FISHING TENT

The framework of a light portable waterproof shelter or tent, large enough to cover two people and useful when fishing on the river-bank, is shown by Fig. 17. The tent is rectangular in shape and open in the front, the frame being of bamboo. The minimum size for two people to sit side by side would be: width, 3 ft.; depth from front to back, 2 ft. 6 in.; height at front, 5 ft.; and height at back, 4 ft. 3 in. The four uprights A (Fig. 17) have the bottoms plugged with pointed hardwood ends for inserting in the ground. The tops are notched, plugged, and

dowelled, as shown at B (Fig. 18), and the side rails D (Fig. 17) are plugged and bored to receive the dowels, as shown at C (Fig. 18). The back rail E (Fig. 17) is dowelled into the side rails, which project at the back far enough to allow the dowels to miss those of the uprights, and the front rail F should project about 9 in. in front of the uprights; and to allow of this, the side rails D are lengthened.

The covering may be of unbleached calico, of which the roof piece only need be waterproof. This should be 6 in. larger all round than the size of the roof frame to form a valance, and this margin may be turned down and sewn at the corners. Tapes, about 6 in. apart, can be sewn to the cover about 7 in. in from the edges for tying the top on to the frame. The sides and back may be in one piece, tapes being sewn on at the edges, as shown in Fig. 19, G showing a tape loose and H a tape tied to the frame. The bottom should be hemmed and have a cord run through; pieces can then be cut out at intervals (*see* Fig. 20) for pegging the sides to the ground. To prevent the tent blowing over, cords are used. These pass over the top frame, being secured to the sides by a hitch to the rails, and are fastened into the ground with tent pegs.

The roof should be painted with a mixture of boiled linseed oil and gold-size; 1 pint of oil to 1 gill of size. If desired, the tent could be easily fitted to a boat. The uprights could be fitted into staples driven into the gunwale, and four cleats used for securing the cords.

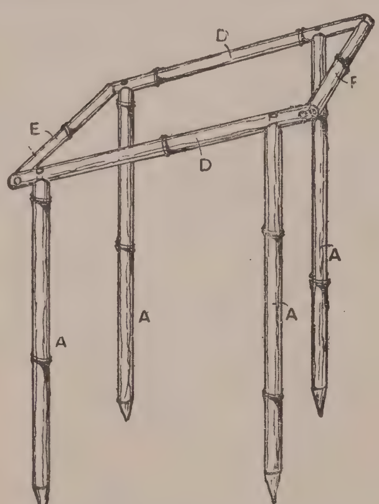


Fig. 17.—Bamboo Framework of Fishing Tent

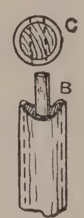


Fig. 18.—Joint at Top of Upright

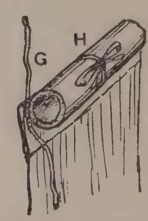


Fig. 19.—Method of Securing Cover

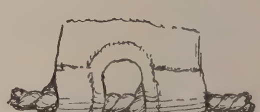


Fig. 20.—Portion of Bottom Edge of Cover

OCTAGONAL WOOD FLOOR FOR BELL TENT

The floor for use in a bell tent may be either temporary or permanent. A temporary floor would be constructed with a few joists and floorboards, but one to be used permanently as a portable floor would require to be constructed on different lines.

Supposing that the diameter of the tent is roughly 13 ft., the floor to make it convenient for handling and packing should be in eight sections. Fig. 21 shows

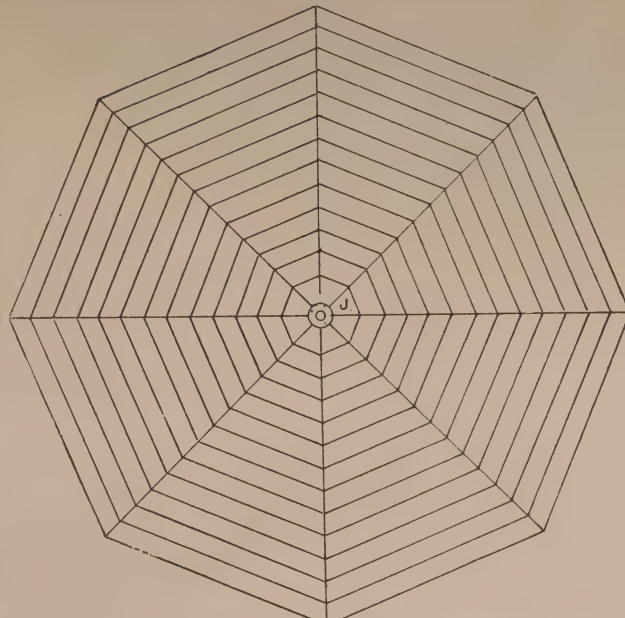


Fig. 21.—Plan of Octagonal Wood Floor for Bell Tent

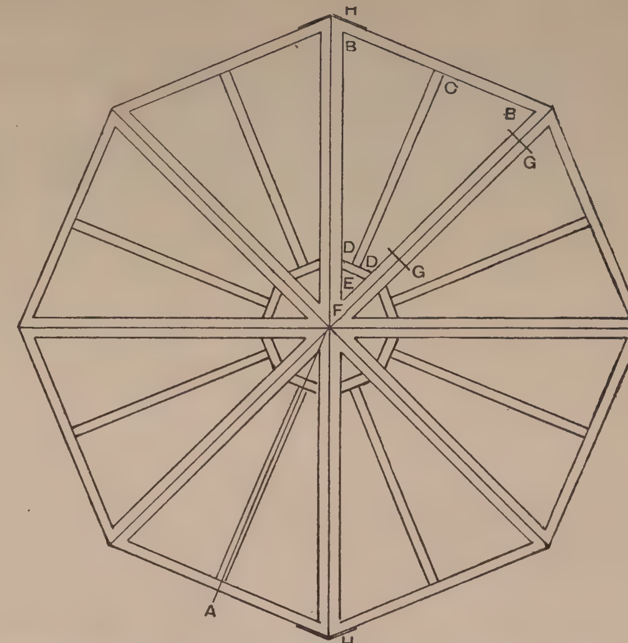


Fig. 22.—Plan of Underside Timber Framing of Floor

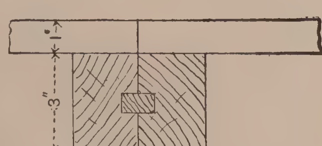


Fig. 23.—Section of Floor through A (Fig. 22)

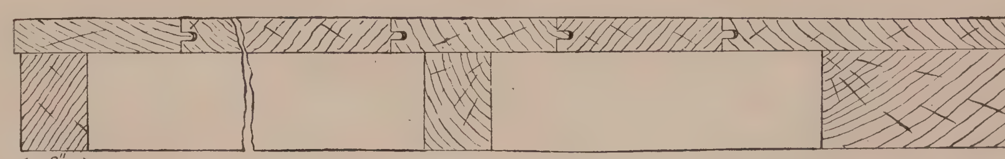


Fig. 24.—Section of Floor through Centre of One Section

the floor as finished, and Fig. 22 shows the underside timber framing. The shape of the floor is consequently octagonal, each section being a triangle. The under framing consists of 3-in. by 2-in. deal framed together, as in Fig. 22. The angles B are dovetailed, mortised and tenoned at C, D, and E, the whole of these joints being pinned through with oak pins. The mitred joint at F is well screwed together. Each section is constructed in the same way, and should be built from the same lines. When finished, the sections are covered with 5-in. by 1-in. tongued-and-grooved flooring, screwed to the framing, as shown in Fig. 21. Fig. 23 is a section through A (Fig. 22).

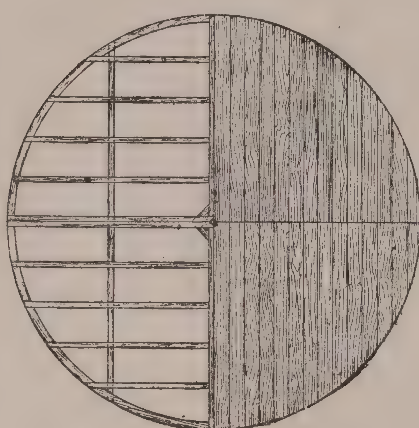


Fig. 25.—Plan of Circular Wood Floor for Bell Tent showing Part of Framework

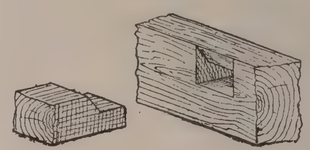


Fig. 27.—Joint between Joists and Plate A (Fig. 26)

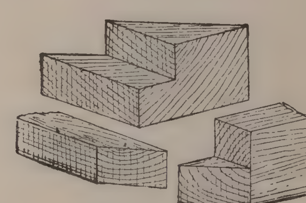


Fig. 28.—Angle Block and Joint

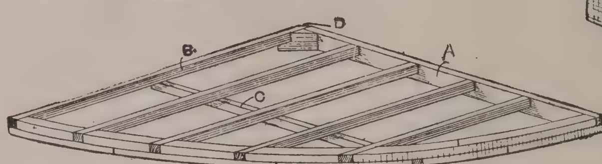


Fig. 26.—Quarter of Framework of Floor

The outer edge of each section of the framing is grooved to receive a hardwood tongue, one side being glued and fixed. This tongue keeps the floor level (*see* Fig. 24). Each joint should be marked with a chisel where the sections come together in the same place. When being put together, each half of the floor is bolted together at the radiating joints (*see* G, Fig. 22), and turned over on to some rough sleeper joists, leaving a space to enable the air to pass beneath. The two half sections may be kept together by means of iron angle brackets screwed on the outer edge at H (Fig. 22). At the centre J (Fig. 21) is an iron plate and socket to receive the centre pole.

CIRCULAR WOOD FLOOR FOR BELL TENT

Another floor constructed on rather different lines is shown by a half plan each of both floor and framework in Fig. 25. This floor is made so as to separate in four pieces when not in use. Fig. 26 is a conventional view of one-quarter of the framework. The plate A should be made of 4-in. by 2-in. stuff, the main joist B and the other joists being of 2-in. by 2-in. stuff. A suitable form of mortise-and-tenon joint for connecting

the joists to the plate A is shown at Fig. 27. The rim is formed of two thicknesses of 2-in. stuff, as shown at Fig. 26, where it will be seen that the joists rest on the lower thickness, to which they are nailed. The spaces between the joists are filled in with strips cut to the curve as shown. The two thicknesses of the rim should be well nailed together. A sleeper C is nailed to the underside of the joists, thus strengthening and stiffening them. The internal angle of each piece having to be partly cut away, it should be strengthened by a block, as shown at D. The block and form of joint is shown to a larger scale at Fig. 28. The floorboards should be grooved and tongued, $\frac{3}{4}$ in. by 4 in. to 6 in. wide, the narrow widths being preferable. They should be nailed to the framing in the usual manner. The curved edges of the floorboards and framing may be cleaned off with a spokeshave.

The whole of the wood should be of good red deal, and the underside treated with a coat of tar. Each quarter should be secured to the two adjacent ones with a couple of $\frac{1}{2}$-in. bolts and nuts, the wing form of nut being very suitable for this purpose.

Poultry Houses

POULTRY HOUSE WITH SHELTERED SCRATCHING-PLACE

A FEATURE of the poultry house (illustrated by Fig. 1 and shown in detail by Figs. 2 to 6) is the provision of a sheltered scratching-place under the roost. The house, as shown, is designed for the accommodation of twelve birds; for twenty birds it should be 7 ft. by 5 ft.; and for forty birds 9 ft. 6 in. by 7 ft. The eaves should be kept to the same height in every case, and the roof should be at the same angle, which will make the centre higher in the larger, and lower in the smaller, houses. It is not proposed to enter into the constructional details of these houses very fully, for the work is largely of the nature of that necessary for shed and outhouse erection which

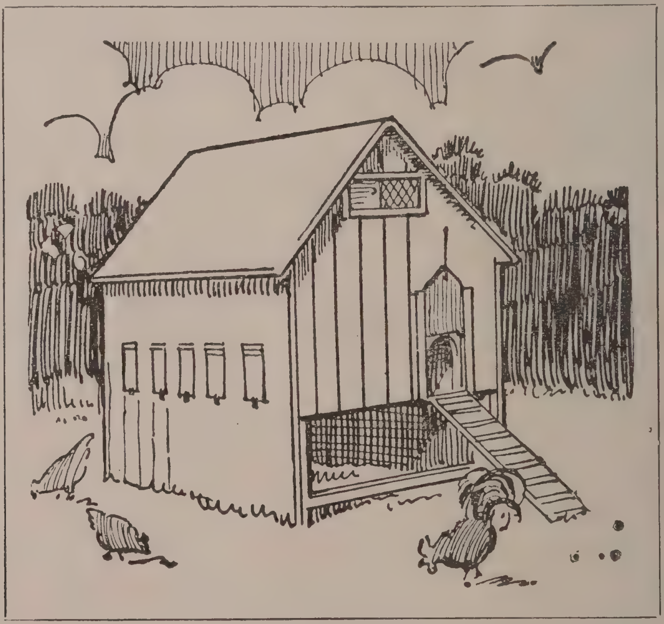


Fig. 1.—Poultry House with Sheltered Scratching-place

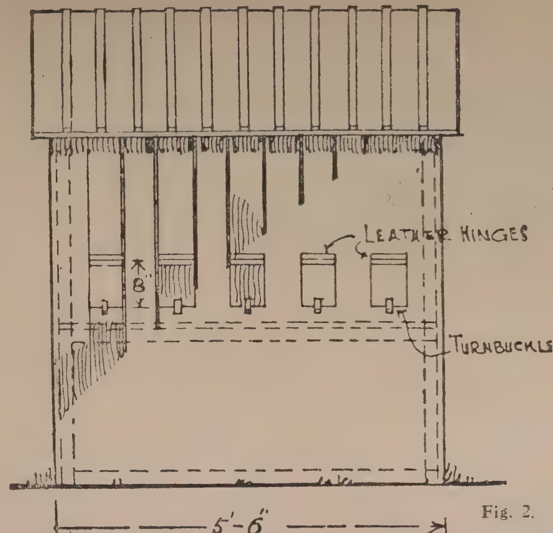


Fig. 2.

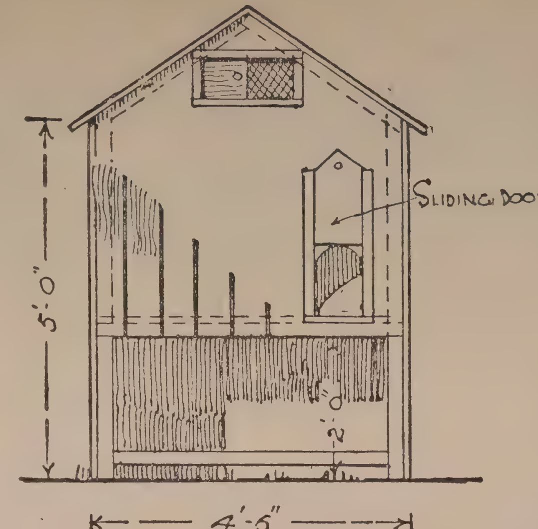


Fig. 3.

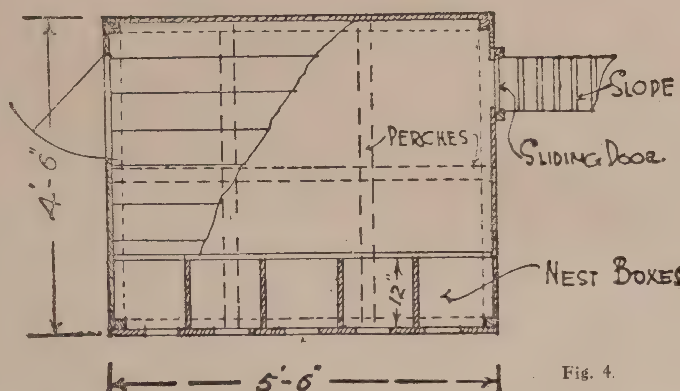


Fig. 4.

Figs. 2, 3 and 4.—Side and End Elevations and Plan of Poultry House with Sheltered Scratching-place

has been fully dealt with in preceding pages.

To construct the house, first prepare a simple framework on the usual lines, as shown dotted in Figs. 2, 3, 4, and 5. Each joint should be notched and then secured with a couple of 2-in. No. 14 wood screws. Make sure that the frame is square, and then nail on the boarding. Five spaces are to be left on one side in the position shown (Fig. 2), which may be fitted with doors hinged with a strip of leather at the top and fitted with a button at the bottom, for the purpose of gathering eggs from the nest-boxes. A doorway 12 in. by 8 in. is cut in the front end in the position shown (Fig. 3), and slide pieces are nailed on each side of this to enable the door to be lifted, an iron pin being used to hold it in position, or it may be hung with a pulley and cord. At the top a large opening is cut at each end and filled in with $\frac{3}{4}$-in. mesh wire for the purpose of ventilation, a sliding shutter, as shown at the top of Figs. 3 and 5, being used to regulate the amount of air for cold or warm weather if the position be very exposed.

The inside of the back end is shown in Fig. 6. A doorway is provided at this end, and the boards are brought down to the ground, but the bottom rail is kept up $3\frac{1}{2}$ in., so that the notches in the corner-posts for this rail and the side sills do not come opposite each other. The object in keeping the front end 2 ft. above the ground, as shown in Fig. 3, is to provide a dry run for the fowls, and this should have dust-baths or should be covered with a few inches of ashes. The floor is covered with 1-in. matchboarding, supported on two or three joists, 4 ft. 4 in. long by $2\frac{1}{2}$ in. by 2 in., to which the boards may be nailed. The floor at the ends rest on the end rails, but should not be nailed if the house is built to take apart. In fitting up the inside, five fixed nest-boxes are provided. To make these, fillets $1\frac{1}{2}$ in. by 1 in. are nailed to the inside of the house, to which a shelf 1 ft. 2 in. above the floor and the full length of the house is fixed. The space under this is divided into compartments, as shown in Fig. 4, an outside door being provided for each (Fig. 2), and a strip (Fig. 4) $2\frac{1}{2}$ in. wide nailed along the front. Three perches are used, two being across the house and one

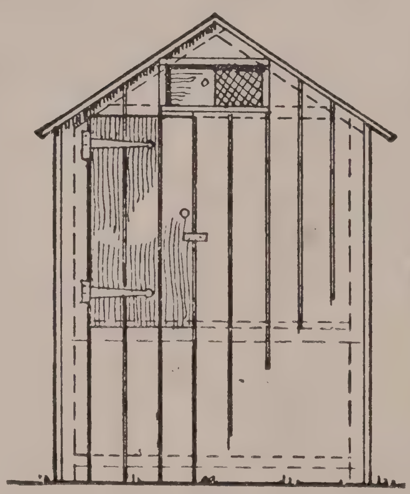


Fig. 5

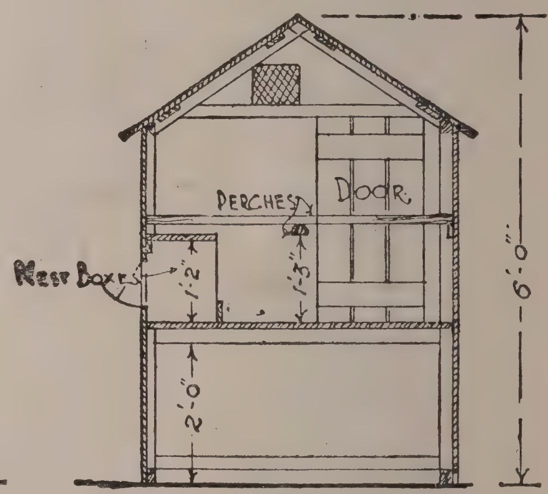


Fig. 6.

Figs 5 and 6.—Elevation of Door-end and Vertical Section of Poultry House with Sheltered Scratching-place

running lengthways in the centre. These may be made by sawing a pole $2\frac{1}{2}$ in. or 3 in. in diameter through the centre, the ends resting on fillets nailed to the ends and sides of the house. The top of the perches should not be more than 1 ft. 6 in. above the floor. A ladder, made by nailing strips across a 7-in. by 1-in. board, must be provided to enable the fowls to enter the house from the run.

POULTRY HOUSE WITH HOOD

A type of house suitable for extension by a simple repetition of the parts to any desired length is shown by Fig. 7. End and part front elevations and plan are shown by Figs. 8, 9, and 10. One of its bays is shown in section in Fig. 11, where the usual dropping-board is seen supported on an end-rail. The top front has a wooden hood similar to that in the last example, shielding an open space (*see* also Fig. 9). Below this in the centre of the 6-ft. bay is an opening, covered in with wire and capable of being closed when necessary by means of frames filled in with glass or canvas, hinged at the bottom, as in Fig. 11. These latter are kept in position when closed by means of turn-buckles at the top. Alternatively they could slide up and down in rebated guides. Doors should be provided in the ends, as in Fig. 8, and can be furnished with small hen-doors at the bottom as shown, closed when necessary by means of a hinged flap. The fronts of the intermediate units of the house will be similar to those of the end portions in every way, unless it be desired to arrange a door in one of them instead of at the ends, which might then be reserved for runs. A long house of this description could be separated into two distinct divisions by means of a central partition, or there are other variations capable of introduction. One upright (Fig. 10) is decentralised to suit the door, for which it forms a rebate, as it projects a little beyond the boarding, whereas the other upright is in the centre of the piece of framing.

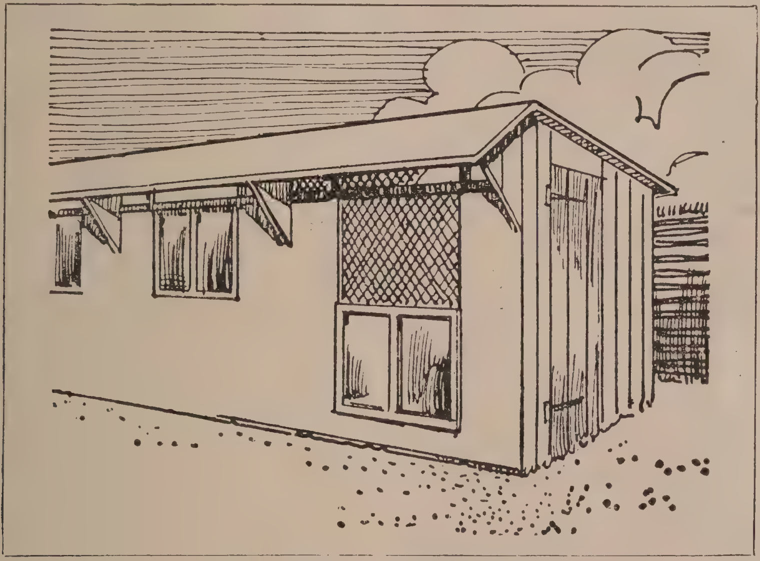


Fig. 7.—Poultry House with Hood

POULTRY HOUSE WITH COVERED RUN

This is another pattern in which a covered run is provided under the hen-roost. The house (Fig. 12) is drawn to

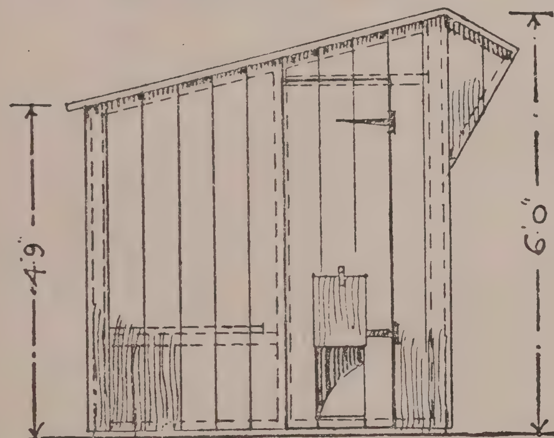


Fig. 8.

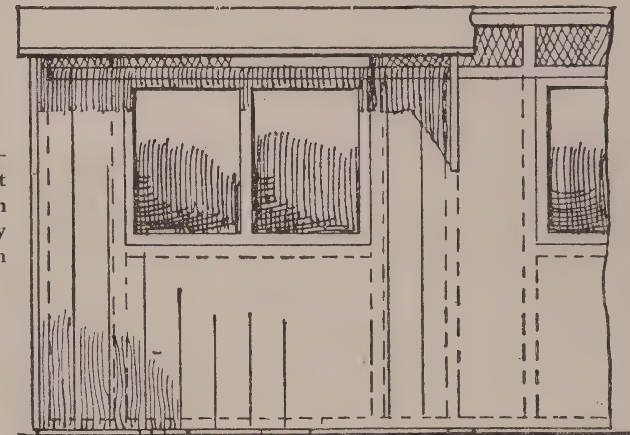


Fig. 9.

Figs. 8 and 9.—End and Part Front Elevation of Poultry House with Hood

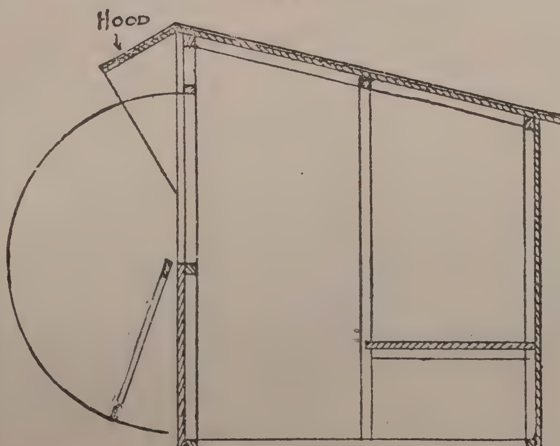


Fig. 11.—Vertical Section of Poultry House

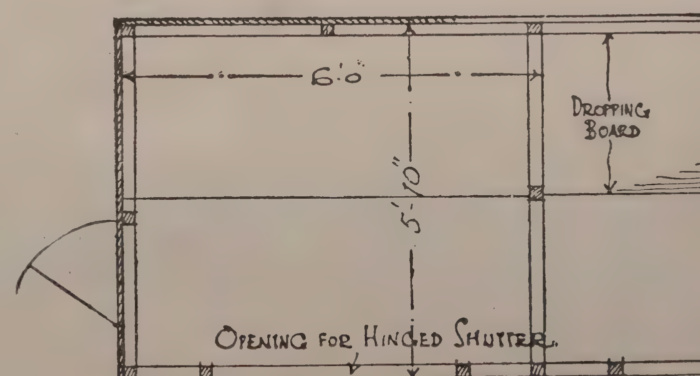


Fig. 10.—Part Plan of Poultry House

the size of 9 ft. by 5 ft., and if built to these dimensions would accommodate comfortably from twenty to thirty fowls. The arrangement of the framework will be gathered from the scale drawings in which the positions of the uprights as well as of two intermediate bearers used to stiffen the floor are shown. The boards of the latter run longitudinally. Two sloping struts will be required to stiffen the front rail, as in Fig. 13, and these can be framed in position, or secured with small blocks or cleats as shown. A hen-door with sloping plank is required (Fig. 13), above which an arrangement of sliding ledged shutters is employed, as in previous cases, whereby the centre of the front can be thrown entirely open or wholly or partially closed at will. The left-hand shutter is shown fully open, and the right-hand one completely closed. Above these again is a narrow, continuous ventilating strip, permanently open and sheltered by the projected boarding of the roof, as in Fig. 14, and also by the triangular pieces at the ends, seen in Fig. 16. At one end the necessary door only leaves room for two projecting sitting-boxes, but there is just sufficient room for four at the other end. A plan of the house showing part of the floor is shown by Fig. 15.

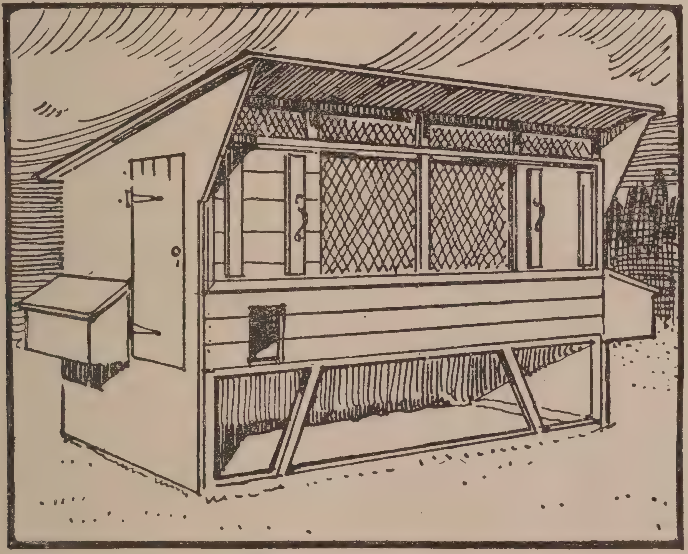


Fig. 12.—Poultry House with Covered Run

INTENSIVE POULTRY HOUSE

The new system of poultry keeping now receiving great attention is one by which the fowls are kept in small houses, to which no runs need be attached, the floors being raised well off the ground. Every care is taken to keep the interiors of the houses as dry as possible, and over the floor is spread a litter of chaff or similar material 3 in. or 4 in. deep. An interesting feature of the system is that the houses do not need frequent cleaning out, and that a house of given dimensions can accommodate many more birds than under the old system.

The size of the house shown by Fig. 17 is 18 ft. long by 14 ft. deep, 7 ft. high at the front, and 5 ft. at the back, but this size may be varied according to the space available. It should be remembered that deep houses are preferable to shallow ones. This house has a partition in the centre,

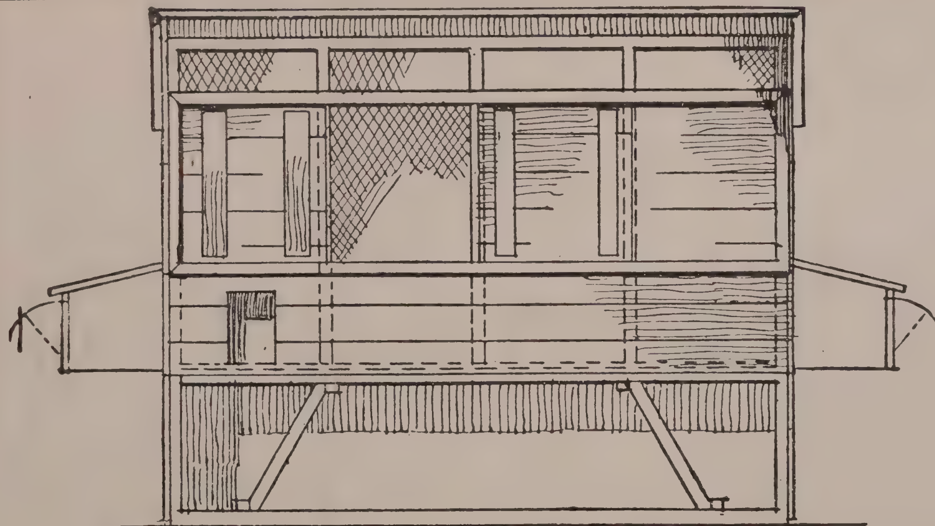


Fig. 13.

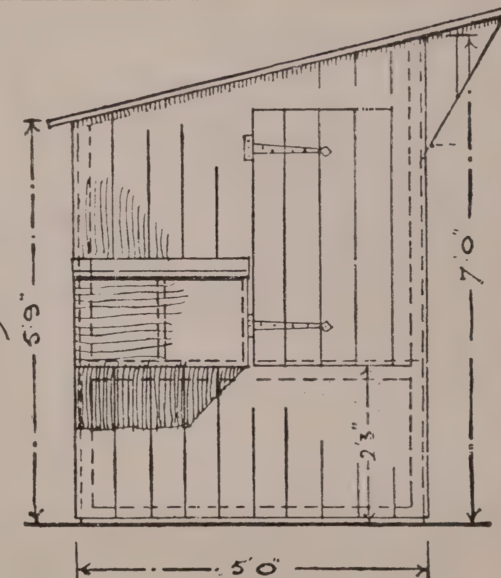


Fig. 14.

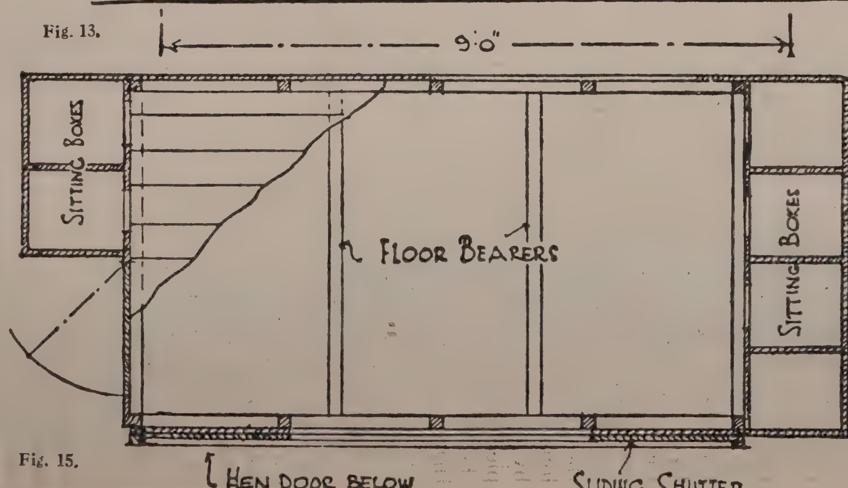


Fig. 15.

Figs. 13, 14 and 15.—Side and End Elevations and Plan of Poultry House with Covered Run

partly boarded and partly covered with wire netting, thus allowing two breeds to be kept separate, that is, two houses in one, each 9 ft. long or wide and 14 ft. deep. For the foundations, eight railway sleepers or similar pieces of timber are placed in four rows about 3 ft. 6 in. apart, with five 9-in. brickwork piers under each row, due care being taken over the levels. If the ground is sloping, an extra course or two of bricks will be required at the back or the front, and it will be better for the drainage. The house should face south or south-west. On the sleepers place thirteen pieces of scantling, 3 in. by 2 in., for the floor joists, one flush with each end, the remainder at equal distances. All the joints in this house are halved, being much simpler and quicker than mortise and tenons, and allowing longer pieces of timber to be used.

Fig. 18 is a general view of the framework of the front, and Fig. 19 the framework of one end. For the front, eight pieces, 9 ft. 6 in. by 3 in. by 2 in., are required if the halving joint is made in the centre as shown by Figs. 20 and 21, or four pieces 18 ft. long without the joining, and four pieces 7 ft. long for the uprights, as shown by Fig. 20. For the back, four pieces 9 ft. 6 in. long are joined, the same as for the front, and three uprights 5 ft. long. The framework of the front and back is made with the 3-in. side to rest on the floor joists; but the ends are made with the 2-in. side downwards. The advantage of this will be found, as the corners when bolted or screwed together make 4-in. by 3-in. corner posts. The framework of the ends consists of one piece 14 ft. long for the bottom; one piece for the top 14 ft. 3 in. long; and for the uprights pieces 5 ft., 5 ft. 6 in., 6 ft. 6 in., and 7 ft. long; also one piece about 5 ft. 6 in. by 2 in. by 2 in. to support the dropping board. Note the front and back uprights are 3 in. above the top bar; this allows for the rafters A (Fig. 19). The two inner uprights are flush, so that two of the rafters can be directly over these. The rafters should project 6 in. over each end, as shown in Fig. 17.

Having got the foundations and floor joists in position, next fit up the front and back framework, and place them on the ends of the joists, nailing to each joist. The ends are not supported on the joists, but on two or more pieces nailed to the outside joists; also to the front and back upright pieces, thus making the 4-in. by 3-in. corner posts. The floorboards can then be nailed in. Then a framework similar to the ends will be required to support the rafters in the centre. This can be covered with netting to form a division in the house if required. The back and ends, also the lowest section of the front, can now be covered with $\frac{3}{4}$-in. matching. It will be found convenient not to board up too much of the ends until after the roof is finished, as it facilitates getting in and out. The two upper sections of the front should be covered with fine-mesh wire netting fixed on the inside.

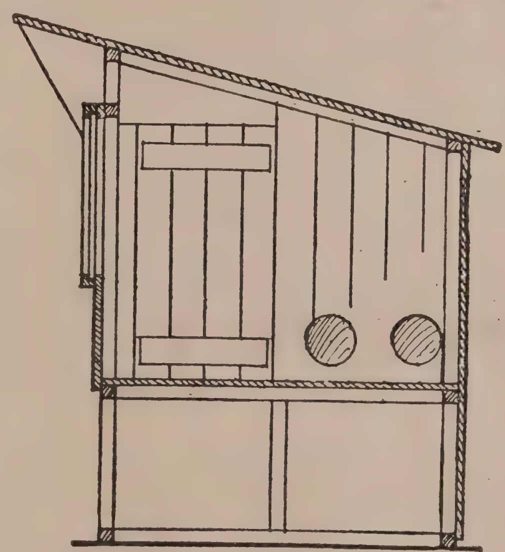


Fig. 16.—Interior of Door-end of Poultry House with Covered Run

Framework doors with fine-mesh netting are fixed inside to allow the wooden doors to be opened in fine weather for extra ventilation. At the back of the house, about 2 ft. from the floor, fix the dropping board C (Fig. 19). This should be 3 ft. wide, and about 6 in. above this place the perches. The nest boxes can be placed where desired. For the six upper divisions of the front make frames of $1\frac{1}{2}$-in. square stuff, to be covered with white calico. The upper three are hinged at the top, and an iron stay secured to fix them open at various angles according to the weather. The lower three can be fastened with buttons, to be taken away in the summer months, or kept fastened in the winter. This house will accommodate sixty birds, thirty in each compartment.

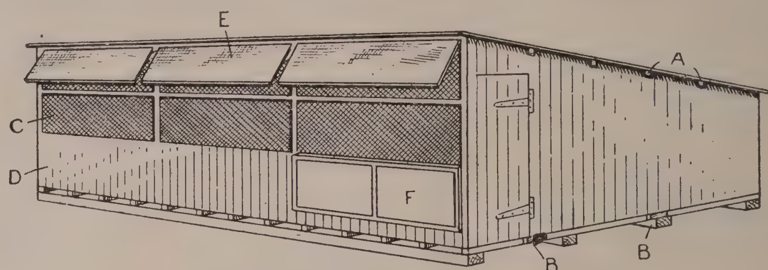


Fig. 17.—Intensive Poultry House

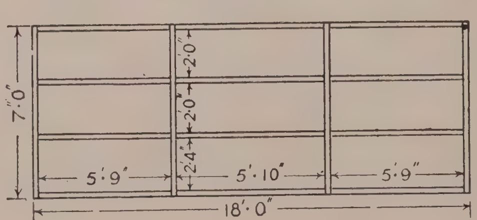


Fig. 18.

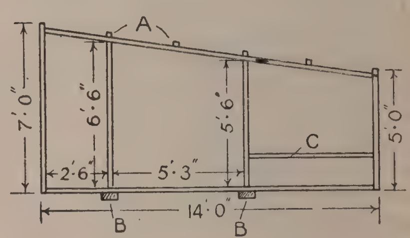


Fig. 19.

Figs. 18 and 19.—Front and End Frameworks of Intensive Poultry House

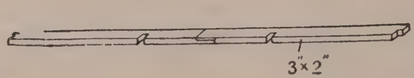


Fig. 20.

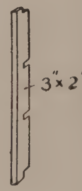


Fig. 21.

Figs. 20 and 21.—Horizontal and Vertical Bars for Front

About 550 ft. of 3-in. by 2-in. material will be required for the framework, rafters, and floor joists; nearly three squares of boards for the roof; just over two and a half squares for the floor; and four squares of matchboarding for outside and

dropping boards. The roof should be covered with sarking felt well tarred; about one and a half rolls being required.

The following are particulars of the letter references in the illustrations (Fig. 17): A represents the ends of the rafters; B the 3-in. by 2-in. blocks nailed to the outer floor joists to support the ends of the house (the ends are bolted to the back and front, and these are to keep the ends from sagging); C the wire netting for the six upper sections of the front; D the matchboarding for the three lower sections; E the shutters covered with white calico, hinged at the top, and fastened at the desired angle with casement stays; and F the shutters for the lower sections (one only shown), hinged at the bottom, hanging down over the matchboard D.

THREE-TIER INTENSIVE POULTRY HOUSE

For erecting the intensive poultry house shown in front elevation and cross section by Figs. 22 and 23, almost any wood at hand can be utilised. The pens to be erected not being large, expensive long lengths of timber are not necessary. Bacon boxes can be had cheaply, and would provide ideal floors. There are some readers who, doubtless, have a shed, where the intensive pens can be erected. If so, the compartments can be constructed to suit the size of the house. Others, with no shed available, can possibly erect a lean-to building against a wall, and thus save erecting the whole back of a house.

To proceed to erect the house first provide five uprights of 2-in. by 2-in. stuff for the front, and fix one at each end. The assistance of a plumb-line will ensure that they are exactly perpendicular. Next take two pieces of 3-in. by $\frac{3}{4}$-in. stuff. Nail one to the top of the two posts, on the front of the upright, close to the roof, and the other level along the floor at the bottom, on the front of the posts. Now fix the remaining three uprights, one in the centre and one each side at equal distances behind the 3-in. by $\frac{3}{4}$-in. piece. Fig. 22 shows their positions. Five more 2-in. by 2-in. uprights are now required for the back. Fix them on the wall and exactly behind the front posts. Ten pieces of 2-in. by 2-in. stuff the width of the house are now cut, and fixed by halving them on to the uprights, from the back to the front. These will form the joists or supports for the two floors. Where the ends of the joists come at the front nail two lengths of 3-in. by $\frac{3}{4}$-in. stuff. The height of the front is now divided into three equal distances. Next lay the floors. Timber from bacon boxes will be found 1 in. thick, grooved and tongued. This is cheap, and the joints will prevent dust falling below. The floor can be fixed lengthwise or across the house, according to the suitability of the timber. Now nail 3-in. by $\frac{3}{4}$-in. stuff on the uprights at the front, so as to level everything up to the four long lengths already fixed. It may be stated that the 3-in. by $\frac{3}{4}$-in. timber is always kept cut to this size by any timber merchant. It is called "wall plate," and is sold by the 100-ft. run. The next wood to use is $1\frac{1}{2}$ in. by $\frac{3}{4}$ in., called "pantile battens." They cost very little, and are tied in bundles of almost any length.

Fix exactly in the centre of the 3-in. by $\frac{3}{4}$-in. stuff, with which the front is covered, the $1\frac{1}{2}$-in. by $\frac{3}{4}$-in. battens. This will form a rebate ready for fitting the doors. Put in the divisions before placing doors over the front. These partitions can be a frame covered with wire, or all wood and fixed with or without exit holes cut in them, with movable doors, for the poultry to pass through. Another kind of division (Fig. 24) is made of wood, with an exit hole (not shown) 7 in. by 10 in. at the bottom, hinged to the floor above or roof, so that it can be lifted up and suspended with a button or hook-and-eye arrangement.

The floor of the bottom tier can be dealt with at any time, requiring, as it does, ashes and cement, or sand and cement. Proceed by levelling the ground roughly. Lay some ashes an inch deep or more, and see that they are down tight. Make a dry mix of sifted ashes, or cement

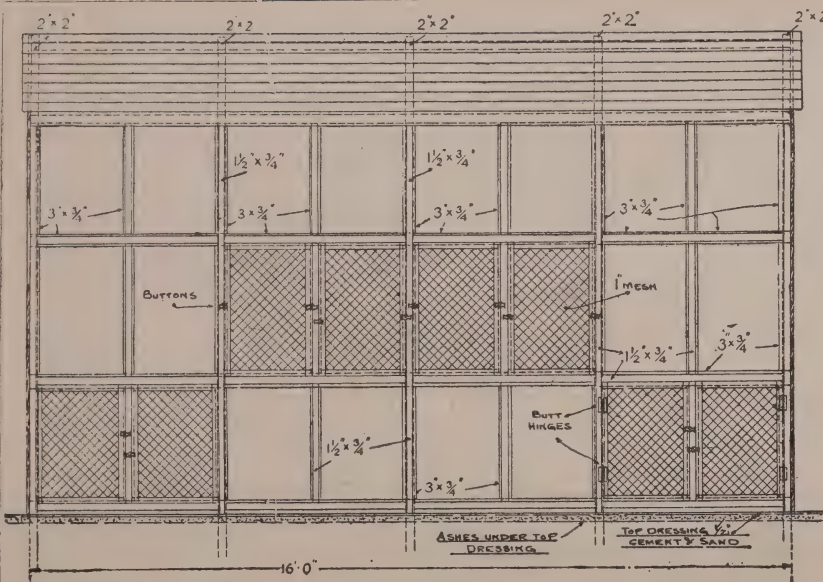


Fig. 22.

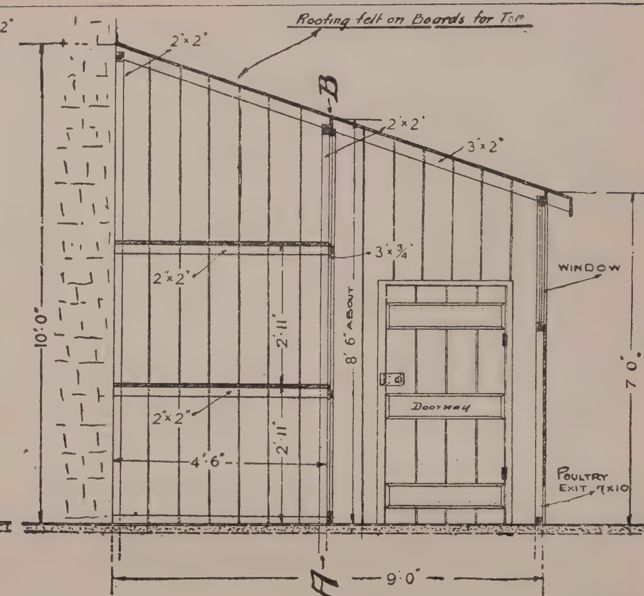


Fig. 23.

Figs. 22 and 23.—Front Elevation and Vertical Section of Three-tier Intensive Poultry House

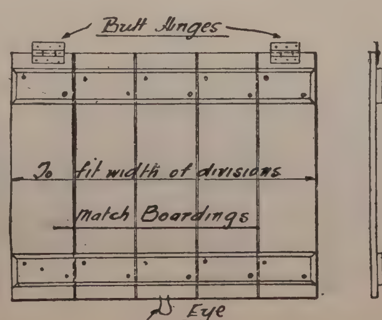


Fig. 24.—Front Elevation of Hinged Partition

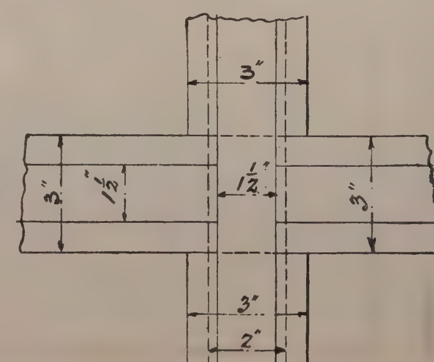


Fig. 25.—Detail of Construction of Front

and sand, 2 parts of sand to 1 part of cement. When well mixed, add water to make into a plaster, and trowel a layer, say This will dry almost as hard as rock. The floor can be made to slope to the front, if desired.

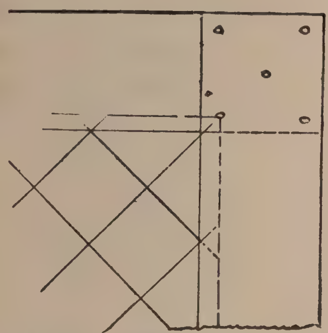


Fig. 27.—Detail of Corner of Door

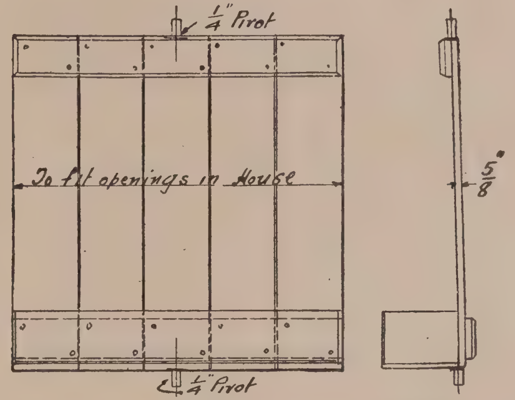


Fig. 29. Fig. 30.

Figs. 29 and 30.—Front and End Elevations of Alternative Door (Pivoted)

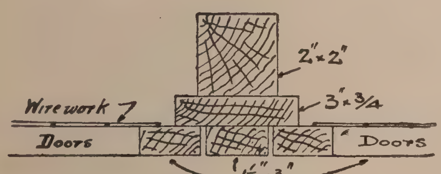


Fig. 28.—Plan Detail of Construction of Front

Fig. 26.—Halved Joint for Door

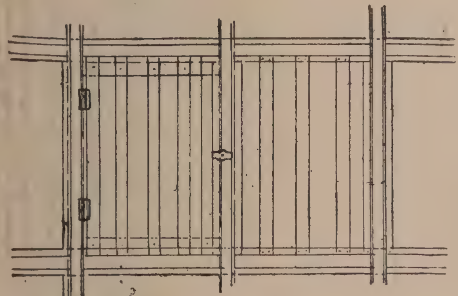


Fig. 31.—Front Elevation of Alternative Door (Parted)

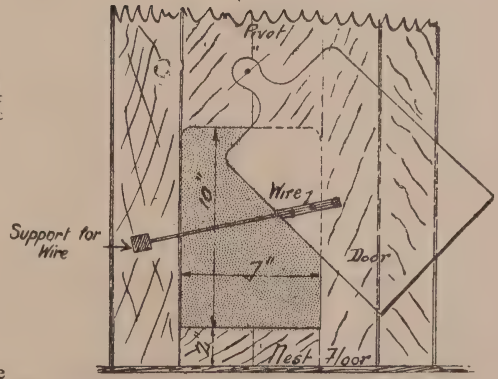


Fig. 32.—Front Elevation of Trap-nest

½ in. thick, all over the floor, doing one pen or compartment at a time. It can be made smooth by using a wet trowel, or brushing over gently with a wet brush.

The fitting of the doors for the pen fronts or compartments can be a matter of individual taste. The style of door as shown in Fig. 23 is suitable. To fit them

up, fix in a length of the 3-in. by $\frac{3}{4}$-in. stuff down the centre of the opening, and on this nail some $1\frac{1}{2}$-in. by $\frac{3}{4}$-in. material. The pen front is now divided into two equal parts. A detail of the house front is shown by Fig. 25. This shows the 3-in. by $\frac{3}{4}$-in. timber, and fixed on it is the $1\frac{1}{2}$-in. by $\frac{3}{4}$-in. batten. Note the rebate this forms for the doors to be fitted loosely into. Measure across the rebate, cut off four lengths for the top, bottom, and two sides. Halve these together into a frame, covering with wire netting, the inch mesh being a suitable size. Fig. 26 shows the method of halving, and Fig. 27 the finished door corner. The halved ends are held together with screws, which should go just through. If they are too long, file down level. Next screw a pair of butt hinges on the door; with the door centred, screw the other part of the hinge to the frame. Fig. 28 shows the 2-in. by 2-in. front upright, the 3-in. by $\frac{3}{4}$-in. stuff fixed to it, and on this again is the $1\frac{1}{2}$-in. by $\frac{3}{4}$-in. batten. The rebate is shown with the doors fitted, and the wire netting tacked to the back. Figs. 29 and 30 show another style of door large enough to fill the entire front, or it can be made the size of half the pen front. Strap together enough matchboard or other wood to fill the opening; drive a piece of $\frac{1}{4}$-in. rod into the centre of the top and bottom, forming pivots, as shown, and fit them into sockets in the front. A receptacle like a shelf, to hold food, water, grit, shell, or what is required, can now be placed at the bottom. Prevent any trough being upset by nailing on a band of tin-plate or galvanised iron. The door inserted in its sockets can be revolved, with food inside, to feed the stock; or outside, to have a fresh supply of food put ready for the next meal. Still another very useful door is shown in Fig. 31. It is so simple that no description is necessary, the front being parted, as described before, but instead of covering it with wire netting, use spars, or lengths of the batten fixed with nails. A shelf fixed below will hold a trough of food, water, or anything required, the birds feeding through the bars.

A nest-box and perch combined can be made simply by nailing a couple of uprights at the centre and up the sides of the nest-box. Cut off a length of perch to fit in between these and nail it in. It will be like the handle of a coal-box. Now, if a top is made removable from between strips of wood, dirt or droppings can be removed very easily.

A suitable type of trap-nest is shown by Fig. 32. It is easy to set, costs little to make, its fall makes no noise and the bird is not hit with violence into the nest-box. Make a front, of any wood, to an ordinary nest-box, and cut an opening as shown. Make the door out of thin wood, 8 in. by 11 in., and fasten the top with a screw as a pivot. The wire seen across the opening is flattened at one end and nailed to the door, a fixture. A support or rest is placed where shown, and this keeps the door from falling down. To enter the nest, the fowl presses in under the wire, lifting up its loose end, causing the thin movable front to fall into place behind her, shutting the bird inside. The outer door can easily be cut out of tin-plate by means of metalworker's hand shears.

COOP FOR BROODY HENS

Broody hens are a constant source of trouble to the poultry keeper, but the trouble may be greatly minimised by providing a few coops of the pattern here described and shown in perspective by Fig. 33.

The coop may be roughly framed together, as shown by Fig. 34, with deal scantling about $1\frac{1}{2}$ in. square. If the maker has the necessary tools and skill, the joints may be mortised and tenoned; if not, a few wire nails to hold the joints together until the boards are fixed will do quite well, as the boards when in position and nailed will hold the framing together. A piece of $\frac{3}{4}$-in. mesh wire netting A is strained across the top of the middle frame, as shown in Fig. 35, and secured with small staples. Three-quarter-inch matchboarding can be used for covering the sides, back, and top, and the front can be made up with vertical strips of 2-in. by

¾-in. deal, as shown in Fig. 33, the middle strip being passed through a slot in the roof boards at the top and secured by means of a hoop-iron socket at the bottom, thus providing one of the simplest forms of opening for putting in and taking out the broody hens. To complete the coop, a feeding trough about 12 in. long by 3 in. by 3 in. is secured to the front of the bars, as shown in Figs. 33 and 35, and is made from ¾-in. stuff.

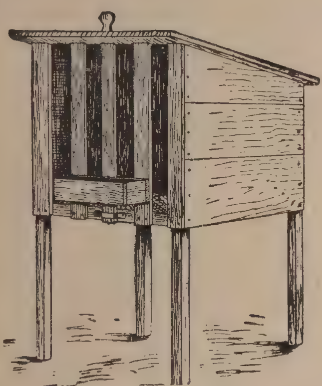


Fig. 33.—Coop for Broody Hens

Fig. 34.—Framework of Coop

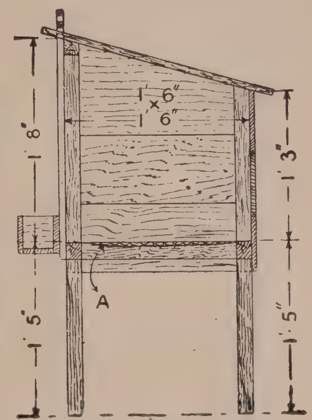


Fig. 35.—Vertical Section of Coop through Centre

The coop is dimensioned 1 ft. 6 in. by 1 ft. 6 in. by 1 ft. 3 in. to 1 ft. 8 in. high; but if a very large breed of fowl is kept, it is desirable to increase the sizes somewhat.

Incubators and Chicken Rearers

HOT-AIR INCUBATOR

The 60-egg hot-air incubator shown by Figs. 1 and 2 has been designed with a view to simplicity of construction, butt joints being used throughout, so that anyone with but an elementary knowledge of carpentry, and few tools, need not be afraid to tackle it.

The wood is of three sizes only, simplifying matters still more. It consists of 25 ft. run of 1 in. by 1 in., either rough or planed (dahlia sticks would do); 50 ft. of stop bead about $\frac{5}{8}$ in. by $\frac{7}{8}$ in. (used for holding window sashes in place, so will be ready planed); 21 ft. super of $\frac{1}{4}$ in. three-ply wood. This is sold in sheets, 3 ft. by 4 ft., so two would be required; or two or three good tea chests would do equally well.

The necessary fittings are obtainable from firms who specialise in poultry appliances. A brief description of them and their functions is here given. The heater, drop-bottom pattern, shown in section by Fig. 3, is the most important.

The lamp fits up against the lower end of the flue A, and its heat passes upwards and out at the vent B, and down below the level of the jacket C. It is most important that the vent B is quite smoke-tight, so that there is no possibility of the fumes from the lamp getting into the fresh-air tube D. The heat of the flue induces a current of air to flow upwards through the space D, and so into the incubator through the lug E. A damper F, worked by the regulator, controls the amount of hot air passing into the machine by allowing the surplus to escape at the vent G. The heater is built up of galvanised iron and iron castings, and is lagged with a thick jacket of asbestos H. It is fixed with screws through the flange J to the side of the incubator. The hot-air pipe (Fig. 4) is made out of stout tinplate 15 in. long and 2 in. in diameter, with a flange about $3\frac{1}{2}$ in. square soldered $1\frac{1}{2}$ in. from one end. The pipe should be lap-seamed. Another piece of tin $3\frac{1}{2}$ in. square and a piece 17 in. by 3 in. are also required. A piece of asbestos board, say 6 in. square by $\frac{1}{8}$ in. thick, will be required to go under the flange and round the tin tube. The thermometer should be of the hanging variety, and is hung from the centre bar of the upper diaphragm by two screw-eyes. The bulb should be 2 in. above the egg-trap bottom. The lamp (Fig. 5) is 6 in. in diameter, and 2 in. deep, and is fitted with a $\frac{7}{8}$-in. burner. With the usual burner a chimney will be required.

A bi-metal regulator is shown by Fig. 6. The thermostat A, which is suspended by the connecting tube B just above the egg tray, is made of two metals having unequal expansion, such as aluminium and steel, or zinc and steel. When the heat in the egg chamber reaches about 100°, owing to the unequal expansion of the two metals, the thermostat has a tendency

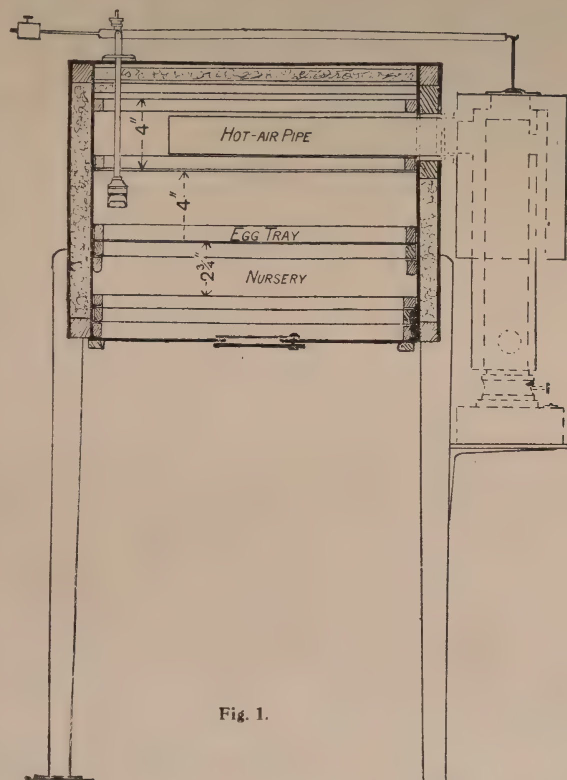


Fig. 1.

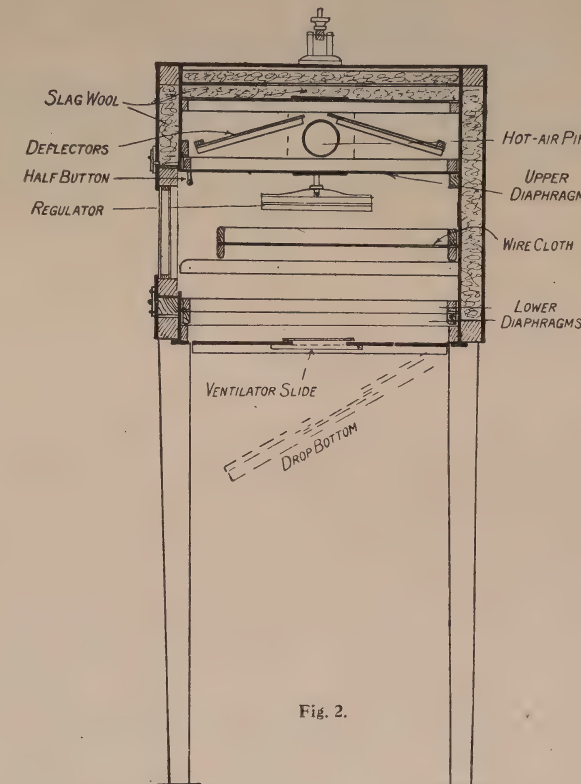


Fig. 2.

Figs. 1 and 2.—Longitudinal and Cross Section of Hot-air Incubator

to buckle and exerts a pull on the pull rod C, which in turn is connected to the beam end D. This beam is pivoted to the base-plate E, so that the pull working the damper again. This action is almost imperceptible and quite automatic. The base-plate E is screwed to the top of the incubator, and the connecting tube is 7 in.

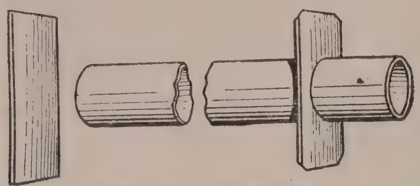


Fig. 4.—Hot-air Pipe

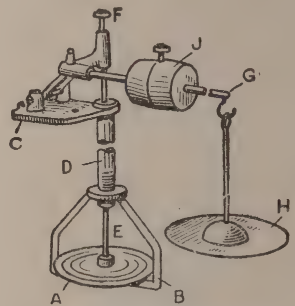


Fig. 7.—Capsule Regulator and Attachments

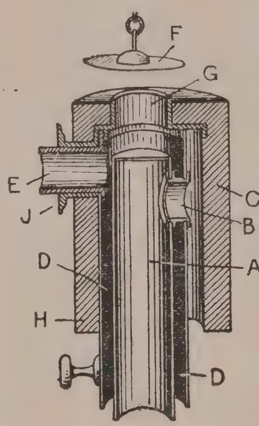


Fig. 3.—Section of Heater

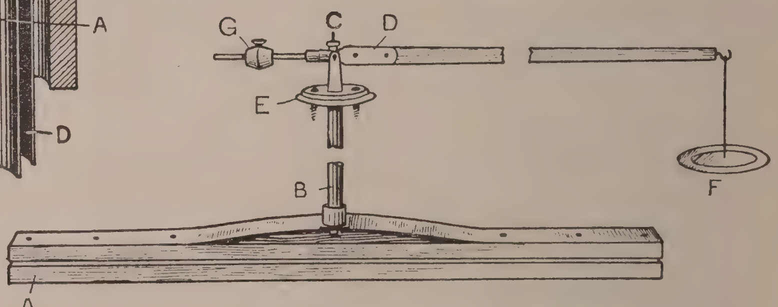


Fig. 6.—Bi-metal Regulator and Attachments

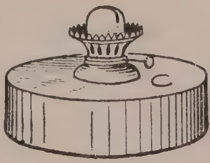


Fig. 5.—Heating Lamp

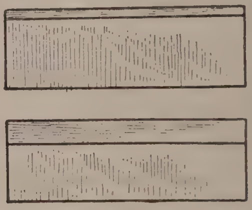


Fig. 8.—Deflectors

through the beams lifts the damper F off the heater top, and allows the surplus heat to escape until the heat of the egg chamber goes down. The thermostat regains its original position and drops

long. The counterpoise G is adjusted to balance the beam, so that the slightest movement takes effect. Although the bi-metal regulator is the one used in most hot-air machines, the capsule regu-

lator (Fig. 7) is equally as good, and considered by many better. A capsule A rests on the holder B, which in turn is connected to the base-plate C by the tube D. The capsule, which is composed of two pieces of brass soldered together at their edges, contains a liquid which boils, and therefore expands, at a temperature of about 100°, bulging out the capsule. This movement is communicated through the needle E to the adjusting screw F and lever end. This lifts the lever rod G and the damper H, the weight J in this case exerting a downward pressure on the capsule, making its action more steady. If it is desired to use gas, the base-plate is replaced by one containing a gas valve controlled by the end of the lever rod. The damper is not connected to the lever end, but is placed loosely over the heater vent. The valve turns down the gas automatically. A pair of deflectors (Fig. 8) will also be required. They are of strawboard $17\frac{1}{2}$ in. by $5\frac{1}{2}$ in., and the upper edge, that is, the one nearest to the hot-air pipe, is edged with tin 1 in. on the underside, with $\frac{1}{2}$ in. turned over the top edge. Two strips of stop bead $17\frac{1}{2}$ in. long are cut for each, and the deflectors nailed to them, one at the lower edge and the other up against the tin, both strips on the upper side. Other requirements are: one piece of wire cloth $17\frac{3}{4}$ in. by 13 in. for the egg tray, and one piece about 4 in. square for the ventilator; three pieces of canvas 18 in. by 15. in. for the diaphragms (fairly close woven, that used for baling cloth is suitable); two pieces of felt 18 in. by 15 in. of not too close a texture; three pieces of strawboard 18 in. by 15 in.; 4 lb. of cotton batting, cotton-wool, or wadding for the top packing; two pieces of glass, 16 in. by 5 in. bare, for the door; two pairs of $1\frac{1}{2}$-in. brass back flap hinges; two pairs of brass buttons; 1 pair of brass half-

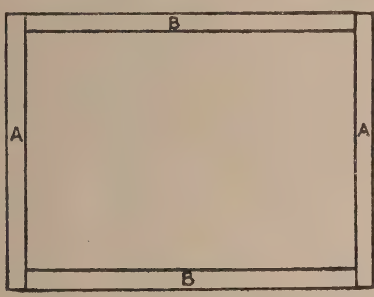


Fig. 9.—Back of Incubator

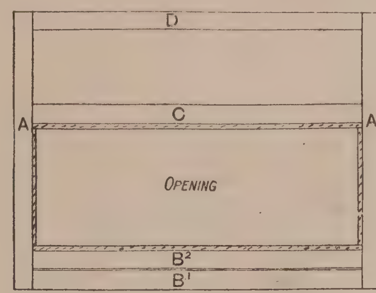


Fig. 10.—Front Framing of Incubator

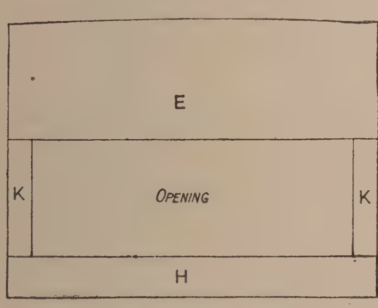


Fig. 11.—Inside Front of Incubator

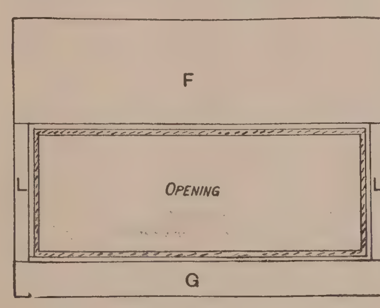


Fig. 12.—Outside Front of Incubator

buttons ; one brass knob ; one pair of 6-in. shelf brackets ; and one set of legs or 10 ft. of 2-in. by 2-in. stuff.

The back (Fig. 9) should be made first. Cut two pieces of three-ply wood 20 in. by 15 in., two pieces A of 1 in. by 1 in. 15 in. long, and two pieces B of 1 in. by 1 in. 18 in. long. Nail one piece of three-ply to these battens, putting the pieces A at each end with the outer edge flush, and the pieces B in between and flush with the other edges. This forms a box 1 in. deep, and is filled with some non-conductor, such as sawdust, flock, cotton-wool, or better still slag-wool, which, although more expensive, is one of the best non-conductors. Upon these double walls depend the success of the machine. When the packing is done, nail the other piece of three-ply on the top, and the back is complete.

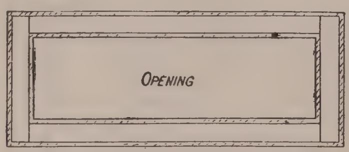


Fig. 14.—Door of Incubator

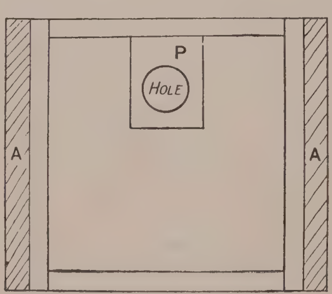


Fig. 15.—Side of Incubator

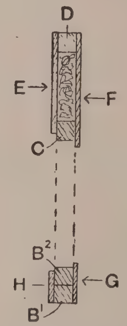


Fig. 13.—Section of Front Framing

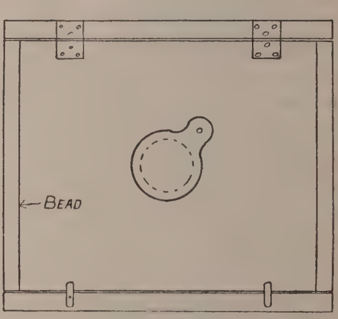


Fig. 16.—Bottom of Incubator

For the front (Fig. 10), cut two pieces A of batten 1 in. by 1 in. 15 in. long ; four pieces, B^1, B^2, C and D, 18 in. long ; one piece of three-ply E (Fig. 11) 20 in. by $6\frac{1}{4}$ in. ; one piece of three-ply F (Fig. 12) 20 in. by $5\frac{3}{4}$ in. ; one piece of three-ply G 20 in. by $1\frac{3}{4}$ in. ; one piece of three-ply H 20 in. by $2\frac{1}{4}$ in. Place the five pieces of batten in the positions shown in Fig. 10, and nail the piece E to them, keeping the edges flush with D and at each side A, but allowing it to overlap C by $\frac{1}{4}$ in. Nail the piece H to B^1 and B^2, the sides A overlapping B^2 towards C for $\frac{1}{4}$ in. On the sides A nail two pieces K $1\frac{1}{4}$ in. by $6\frac{1}{2}$ in. coming in between E and H (Fig. 11). Then turn the frame over. There is now a frame partly covered, with an opening 7 in. by 18 in., having a $\frac{1}{4}$-in. rebate inside, which is for the door (*see* Fig. 14). The insides of these battens are best planed. Now fill in the space between D and C with the non-conductor, and nail on the piece of three-ply F, keeping it flush with the edge D, and it will fall short of the edge C by $\frac{1}{4}$ in. (*see* section, Fig. 13). Nail on to B the piece G, keeping it flush with the outside edge of B^1. Two pieces of three-ply L are now cut to nail on A, $\frac{3}{4}$ in. by $7\frac{1}{2}$ in. between F and G, keeping them flush on the outside edges. This forms another rebate $7\frac{1}{2}$ in. by $18\frac{1}{2}$ in. This side forms the outside of the incubator (Fig. 12).

The door must now be made to fit the opening. Cut two pieces of 1 in. by 1 in. 7 in. long, and two pieces 16 in. long. These being in sight are best planed ; but do not take too much off, or the door

will not fit close. Cut a piece of three-ply $18\frac{1}{2}$ in. by $7\frac{1}{2}$ in., to be an easy fit in the outside rebate formed by F, G, L, L (Fig. 12). A piece is cut out of this $15\frac{1}{2}$ in. by $4\frac{1}{2}$ in., leaving a frame $1\frac{1}{2}$ in. wide. Nail this to the battens in position, as shown in Fig. 14, leaving a $\frac{1}{4}$-in. rebate both inside and outside the frame. The corner of the frame should be nailed with a couple of 2-in. oval wire nails, making the holes with a bradawl first to prevent splitting. Fit this into the opening, making as good a fit as possible without the door binding; hang with $1\frac{1}{2}$-in. brass hinges to G, and fit turn buttons on F (Fig. 12).

For the left-hand side cut two pieces 1 in. by 1 in. and 15 in. long; two pieces 1 in. by 1 in. and 13 in. long; one piece of three-ply 15 in. by 15 in.; and one piece of three-ply 15 in. by $17\frac{1}{2}$ in. Make up and pack the same as for the back; but allow the longer piece of three-ply to project at each side $1\frac{1}{4}$ in. (*see* A, Fig. 15). This is the outside.

The right-hand side is made in a similar way, but a piece of 1-in. wood P, 5 in. by 4 in., is put in the position shown in Fig. 15. A hole $2\frac{1}{4}$ in. in diameter is cut through the two pieces of three-ply and the block P to take the hot-air intake, the centre being $3\frac{3}{4}$ in. from the top and midway from the sides.

The case may now be put together, the sides going in between the back and front, and the $1\frac{1}{4}$-in. piece of three-ply that overhangs on the sides covering the edges of the front and back. They may be screwed or well nailed. Nail pieces of the stop bead all round the inside, with their top edges $1\frac{3}{4}$ in. from the top of the case, the square edge upwards. Other pieces of the stop bead are nailed all round the inside flush with the bottom edge, square edge upwards. The bottom frames will rest on these. Two pieces of stop bead 15 in. long are nailed to the two sides, the top edge being $11\frac{1}{2}$ in. from the top of the case. These are the runners for the egg tray. Another piece of stop bead $17\frac{1}{2}$ in. long is nailed to the back inside, with the upper edge $6\frac{1}{4}$ in. from the top edge of the case; on this will rest the back edge of the upper diaphragm. A piece of stop bead is also nailed to the front inside, with its lower edge $5\frac{1}{2}$ in. from the top edge of the case, square edge downwards.

The drop bottom is made of a piece of three-ply 14 in. by 18 in., with a 3-in. hole in the centre and two pieces of stop bead 14 in. long nailed to its edges (*see* Fig. 16), and is hinged to the back by small hinges. A piece of three-ply 1 in. by $16\frac{1}{2}$ in. is nailed to the back, to take the hinge, and a piece the same size to the front, to take turn buttons that keep the bottom in place. Cut a 4-in. circle of three-ply wood, having a lug of the shape shown in Fig. 16, and fasten to the bottom with a screw or small nut and bolt, so that it covers the 3-in. hole and can be adjusted so as to make the opening more or less. The egg tray is made of stop bead, and is 13 in. by $17\frac{3}{8}$ in. outside measurement. The corners need only be butted and nailed with $1\frac{1}{4}$-in. oval wire nails. Nail to this frame a piece of $\frac{1}{4}$-in. mesh wire cloth 13 in. by $17\frac{3}{8}$ in., and nail other pieces of stop bead on the top with the round edge upwards. This will make a strong and easily made frame.

Now make two frames, 15 in. by $17\frac{1}{2}$ in., of the stop bead, and cover them with fairly close-woven canvas. These are the bottom frames, and should be an easy fit in the bottom of the incubator, where they go one on top of another. Two pieces of felt are placed between these frames to regulate the ventilation. Another frame the same size is made, with a centre bar of three-ply 3 in. wide set longwise—that is, the $17\frac{1}{2}$ in. way. This is covered with canvas as the others. It rests on the strip nailed to the back, and fits up against the strip on the front, canvas side downwards, being kept in place by buttons secured to the two sides. Cut two pieces of glass 16 in. by 5 in., and put one piece in the door, bedded with a little white-lead or putty. Nail a bead $\frac{1}{2}$ in. by $\frac{1}{4}$ in. on the frame, and putty the other piece of glass on them; put in a few brads, and finish off with putty. This leaves a dead air space of $\frac{1}{2}$ in. between the two glasses.

The heater, which is screwed to the side with the hole in it, can now be fitted. Next the hot-air tube is nailed by its flange inside, with the small hole upwards.

Put the upper diaphragm in place, and fix a small block to support the hot-air tube at its extreme end. Fix the deflectors in place in the position shown in Fig. 2, using the stop bead for supports. They should be $1\frac{3}{4}$ in. apart at the top, and start 3 in. below the top edge of the case and slant 2 in. downwards. Cut a piece of strawboard 15 in. by $17\frac{1}{2}$ in.; nail to it in the centre and longwise a piece of three-ply 3 in. wide, and to the wood a piece of tin the same width. This is to protect the strawboard from the incoming heat. Put this in the top of the incubator, tin side downwards and resting on the ledges $2\frac{1}{4}$ in. from the top. Fix a block 2 in. square by 3 in. long on the left-hand side above this, through which will be drilled a hole to take the connecting tube for the regulator. The space left is filled with alternate layers of thin strawboard and cotton-wool. Then cut a piece of three-ply to cover the top, and screw down. Bore a $\frac{1}{2}$-in. hole in the top 3 in. from the left-hand side and midway back to front. Mark where this hole should come in the upper diaphragm; remove the diaphragm and bore the hole. Put the diaphragm in position again, push the connecting tube of the regulator upwards, and screw on the top work and the base-plate to the top of the incubator. When ordering, state that the distance between the diaphragm and the top of the case is $6\frac{1}{2}$ in., and the distance from the centre of the thermostat to the end of the case is $7\frac{1}{2}$ in.

The legs are now to be fitted. These may be made of 2-in. by 2-in. stuff 2 ft. 6 in. long, tapered to $1\frac{1}{2}$ in. at the bottom, with a piece cut out 1 in. deep and 6 in. long. Screw a leg to each corner of the sides, so that the incubator rests on the shoulder formed by taking out the piece. A pair of shelf brackets are screwed to the legs on the heater side, and a three-ply shelf, 7 in. by 18 in., screwed to them. They are fixed at such a height that when the lamp is in position in the heater there is room for a piece of wood, say, 1 in. thick between the shelf and the lamp bottom, thereby holding it in place. This block is withdrawn when the lamp is to be attended to, and the shelf forms a useful support for this purpose. Fix the screw eyes for the thermometer into the centre of the upper diaphragm, so that the bulb is 2 in. above the wire cloth of the egg drawer. Give the machine a good rub down with glasspaper, punch all the nails and stop with putty. A good stain is made with brunswick black or cycle japan diluted with turpentine. Finish with a coat of varnish.

Any cellar or downstairs room away from draughts, direct sunlight, and slamming doors is the best place to set the machine. Thoroughly warm the machine up, and leave running for a couple of days before putting in the eggs.

HYDRO OR HOT-WATER INCUBATOR

The hydro or hot-water incubator now about to be described has served as a model for very many makes, and has been of substantially the same design since about 1881.

The illustrations, Figs. 17, 18 and 19, show two elevations and plan of a 50-egg incubator with drying box. Three sections are shown by Figs. 20, 21 and 22.

The outer case is made of $\frac{3}{4}$-in. yellow pine, in the form of a square box 20 in. long, 20 in. wide, and $17\frac{1}{2}$ in. from the top of the base-board to the underside of the top, dovetailed at the corners. Both base and top are also of pine, with the edges rounded, the base being in one piece. The top—apart from the glazed lid at the front—is in narrow widths, secured by round-headed brass screws, with washers under their heads. The opening for the drawer, $15\frac{1}{2}$ in. long and 5 in. high, is cut in the front of the case, 1 in. above the top of the base-board. On a level with the bottom of this opening is fixed the inner floor, on which the drawer slides. As shown, there is a $\frac{1}{2}$-in. space between the inner bottom and the base for ventilation purposes, the air passing in through four holes bored in the corners of the base, and finding its way into the egg chamber through a central hole in the inner bottom. The water

tank is 17 in. square and 4 in. deep, and is made of copper; it is traversed by a flue $1\frac{3}{4}$ in. in diameter and 13 in. long from the outside of the water jacket, which extends to the outside of the case. The return flue is $\frac{5}{8}$ in. from the other, and the two are arranged to occupy a central position, widthways, in the tank. Where they pass through the woodwork of the case and the packing, the flues are encased in a water jacket $4\frac{3}{4}$ in. wide, $2\frac{3}{8}$ in. deep, and $1\frac{1}{2}$ in. long, the upper corners of which are quadrant shaped. There is a false bottom, which may be of perforated zinc, arranged about $\frac{3}{4}$ in. from the bottom of the tank. Between the top of the tank and the underside of the lid there is a space of $4\frac{3}{4}$ in., and, $8\frac{3}{4}$ in. from the inside of the front of the case, this space is partitioned off by a $\frac{5}{8}$-in. board running right across the case, and this forms a drying box for the newly hatched chickens. As seen in Fig. 20, a floor, $\frac{3}{8}$ in. thick and $7\frac{3}{4}$ in. wide, is fixed, distant $3\frac{1}{2}$ in. from the underside of the lid; this allows a space of about $\frac{7}{8}$ in. between the lower side of the floor and the top of the tank; to the edge of this floor a $\frac{1}{2}$-in. upright, $2\frac{1}{2}$ in. wide, is fixed, and along the upper bank edge of this upright piece a strip of coarsely perforated zinc is tacked.

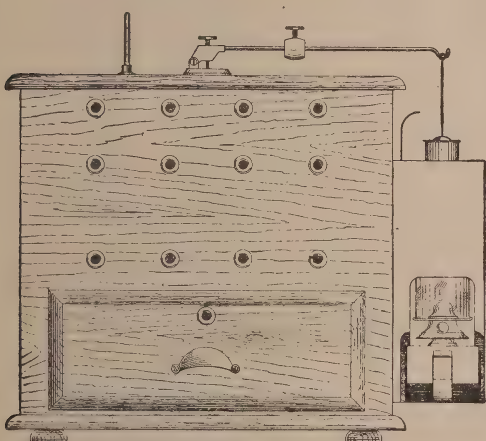


Fig. 17.

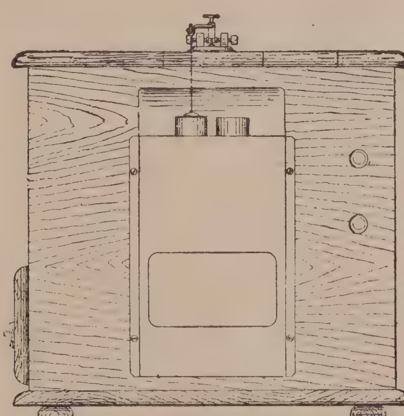


Fig. 18.

Figs. 17 and 18.—Front and End Elevations of Hot-water Incubator

In Fig. 17 three tiers of ventilation holes are shown, each hole being furnished with a $\frac{1}{2}$-in. brass eyelet; those in the lower row serve as outlet ventilators for the egg chamber—the inlets being through the base, as previously mentioned. A similar row of holes is provided at the back of the case. The middle row of holes serves as inlets for fresh air, which is warmed as it passes over the tank, and passed between the partition and the $2\frac{1}{2}$-in. upright piece, through the perforated zinc, into the drying box, finally escaping, laden with the moisture from the drying chicks, through the upper row of holes. The glazed lid, forming the front portion of the top, by which the chickens are introduced and removed, fits over the drying box, and is not fixed, but is kept in position by small fillets tacked to the underside.

The opening which takes the egg drawer is $15\frac{1}{2}$ in. wide, $17\frac{3}{4}$ in. from the front of the case to the partition supporting the tank, and $7\frac{3}{4}$ in. high from the surface of the inner floor to the bottom of the tank. The egg drawer is an easy fit in the $15\frac{1}{2}$-in. by 5-in. hole cut in the front of the case, and is $17\frac{1}{2}$ in. long from inside the false front, which, as will be seen, overlaps the drawer opening about $\frac{5}{8}$ in. all round. The inside measurement of

the drawer is $14\frac{1}{2}$ in. square. The wood frame, which is covered with perforated zinc, and forms the bottom upon which the eggs rest during incubation, allows a space of $1\frac{7}{8}$ in. round the sides of the drawer, and the concavity of this zinc bottom allows the eggs in the centre of the drawer to be $\frac{7}{8}$ in. lower than those at the extreme sides. For noting the temperature of the egg drawer, a hole is bored through the drawer front; outside it is bushed with a brass eyelet, and inside it is fitted with a paste-board tube of about $\frac{3}{8}$ in. internal diameter, which projects $2\frac{1}{2}$ in. inside the drawer. The centre of this hole is $\frac{1}{2}$ in. below the drawer top, and when in use the thermometer bulb projects slightly beyond the inner end of the paste-board tube, and is thus in the correct position for recording the heat reaching the whole of the eggs, the concavity of the bottom of the egg drawer compensating for differences of temperature which exist between the centre and the outsides of the egg chamber.

The zinc water tray beneath the egg drawer is $12\frac{1}{2}$ in. square, with sides 1 in. high and a hole 4 in. in diameter in the centre. The inner inverted tray of coarsely perforated zinc which supports the damping canvas is 11 in. square and 1 in. high. Over this zinc support a double thickness of coarse canvas is used, and dips all round in the water contained in the tray, so all air passing into the incubator is filtered through the wet canvas and moistened in its passage. A single thickness of the dry canvas is used under the eggs in the egg drawer.

The apparatus for regulating the heat includes a metal capsule (to be obtained from fittings manufacturers). The bottom of the tripod upon which this capsule rests is $2\frac{7}{8}$ in. from the bottom of the tank, and the needle tube which supports the tripod is arranged in the centre of the egg drawer. Heating arrangements

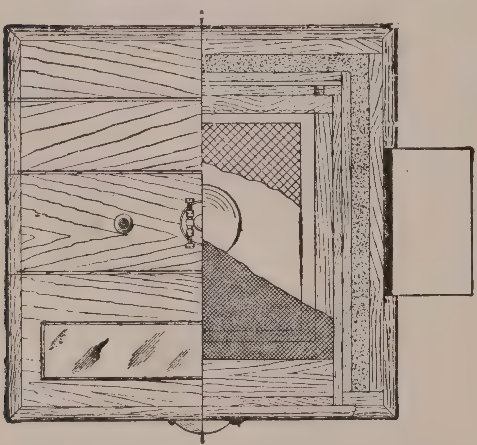


Fig. 19.—Part Plan of Lid and Part Horizontal Section through Egg Chamber

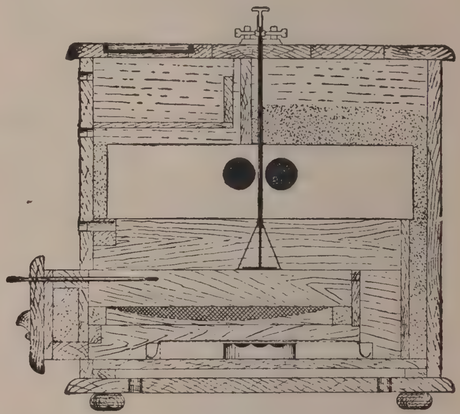


Fig. 20.—Vertical Cross Section through Centre of Incubator with Drawer partly Open

consist of a lamp box, 13 in. high 8 in. wide, with a projection of 5 in., of which $\frac{1}{2}$ in. consists of an air space between the lamp box proper and the side of the case. The upper portion of the lamp box to a depth of $6\frac{1}{4}$ in. contains in the front portion a ⊣-shaped inlet flue, and in the back portion a ⅃-shaped outlet flue, both $1\frac{3}{4}$ in. in diameter. The flues in the lamp box are embedded in some non-conducting composition to connect them with the flue traversing the tank, a couple of nipples or connectors are employed, $2\frac{1}{4}$ in. long, and of such diameter that they are a good fit in the flues, a reeded band being raised about the centre of each

connector to prevent it being pushed wholly into one portion of the flue. Both inlet and outlet flues extend 1 in. above the lamp-box casing; and, to protect the woodwork of the incubator, the back of the lamp box is extended upward $2\frac{3}{4}$ in. to form a shield, and the upper end is bent outwards to the extent of 1 in. The lamp that supplies the heat is a rectangular vessel made of tinplate, 8 in. long, 4 in. wide, and 2 in. deep, mounted on and hinged to the back of a U-shaped casing of similar dimensions, but 3 in. deep.

Beneath the lamp at the front end, and front of the lamp box, on the bottom of which the lamp slides. When the lamp is pushed quite home the spring is released, and the glass cylinder then beds itself against the bottom of the upper portion of the lamp box so that the burner is immediately below the opening of the inlet flue, whilst the spring exerts its influence to keep the glass tightly in place. For packing between the egg chamber and the case, and also round the tank, ordinary sawdust is employed. The illustrations are strictly to scale, and all minor measurements may be taken from them.

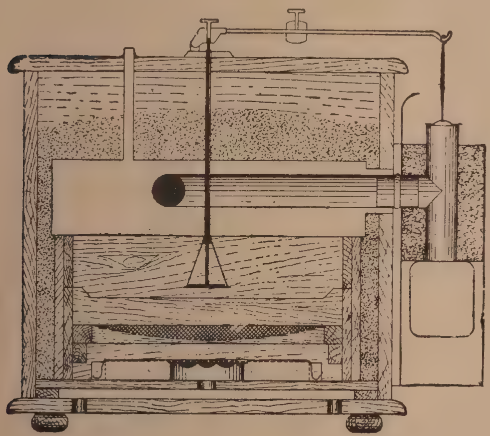


Fig. 21.—Longitudinal Section through Centre of Incubator

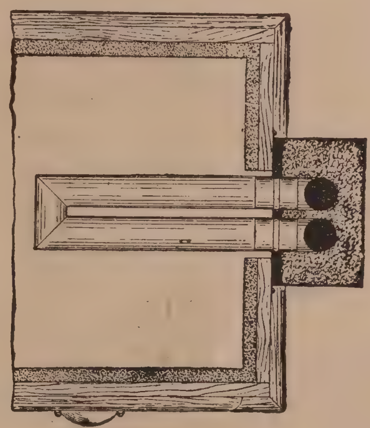


Fig. 22.—Part Sectional Plan of Incubator through Tank

fixed to the bottom of the casing, is a spiral spring; in order to keep the spring in check, a square wire loop is hinged to the casing and passes over a catch soldered to the lamp reservoir. The burner is of the flat-wick type, but of somewhat special construction, obtainable from dealers in incubator fittings; it takes a $\frac{3}{4}$-in. wick, and is fitted with a gallery to accommodate a glass cylinder chimney, about 3 in. long and $2\frac{1}{2}$ in. diameter, which serves as a connection between the lamp burner and the inlet flue in the lamp box.

To place the lamp in position, the spring is depressed so as to allow the glass cylinder to pass into the opening in the

HOT-WATER CHICKEN REARER

While other methods of heating chicken rearers require less expensive and carefully adjusted fittings, the hot-water system, properly installed, provides certain advantages. With it the whole sleeping compartment can be maintained at a uniform temperature, and there is no possibility of the chicks coming in contact with gases or vitiated air from the heater. There is also the added advantage that, if by accident or negligence the lamp should go out at any time, the water would maintain practically the same temperature for a considerable period, whereas any hot-air or direct system of

heating would cool off very quickly. Added to this is the fact that, once the water has attained the requisite temperature, only a tiny flame will be necessary to maintain it at a fairly constant level.

The rearer shown by Fig. 23 is mounted on a framework of legs, in order to facilitate attendance and cleaning operations. When it is desired to work the rearer in conjunction with a run on the grass a lower arrangement is necessary; but in such a case it would be quite simple to provide a table or stand, on which the whole could be placed when brought under cover. Figs. 24, 25, and 26 show front and end elevations and plan respectively.

This rearer will accommodate at least sixty chicks, and consists (as shown on plan in Fig. 26) of a sleeping-place insulated by means of double walls, and heated by an overhead tank, a lamp compartment for heating the tank, and also indirectly warming the next division or "scratching compartment" a little. This latter compartment is divided from the run by means of a removable partition, beyond which the rearer is well sheltered, but has no source of heat. In use, the chicks are at first confined to the sleeping chamber. Later they can be allowed also in the partially warmed compartment during the day, and still later in all three, the partition being finally removed and the top raised to admit sunlight. For this purpose wire guards on wood frames should be substituted for the solid roof.

To construct the rearer a framework of deal about $2\frac{1}{2}$ in. by $1\frac{1}{2}$ in. will be required, the arrangement of which can best be gathered from Fig. 23. There are six uprights (three of which are shown in Fig. 24), three cross-rails 6 in. above the floor level, a long one notched over these, and two other long rails for the front and back, as at A in Fig. 24 and in section at B and C in Fig. 28. Short rails from front to back will not be required for the upper part of the framing, as this will be securely held by the floorboarding fixed across the rails B and C, and also by the end boarding nailed horizontally across, as in Figs. 25 and 27. The whole of the framing should be halved together and screwed. The boarding should be tongued together, and is shown 6 in. wide wherever practicable, that for the black being perfectly plain, and the front arranged with openings as shown. The two outer compartments should have fine wire mesh filled in to their fronts, fixed between wood, as at D in Fig. 26, to cover the cut ends of wire, and in these openings there should be fitted small glass windows consisting of rebated and mitred frames, hinged at the bottom to hang down when not required, as in Fig. 23, and closing on occasion as dotted at E in

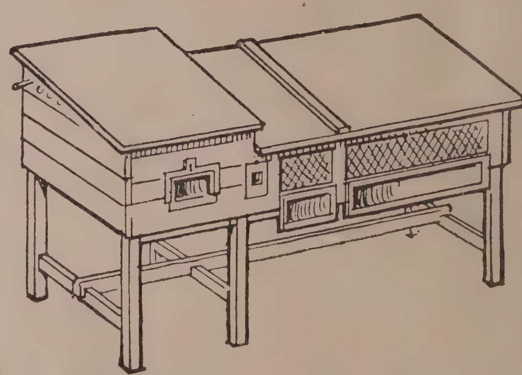


Fig. 23.—Hot-water Chicken Rearer

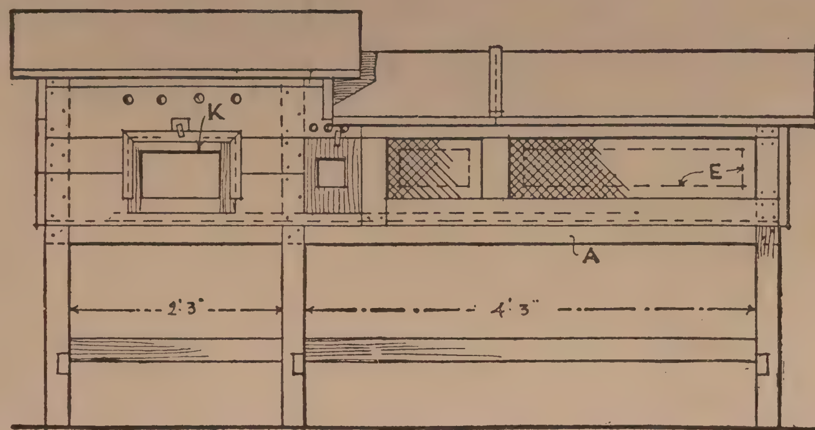


Fig. 24.—Front Elevation of Hot-water Chicken Rearer

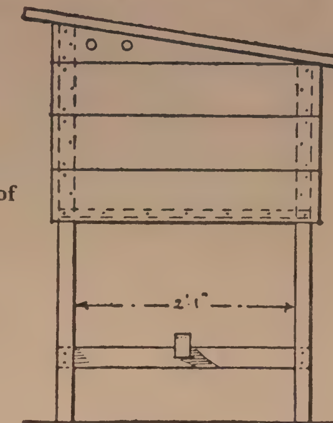


Fig. 25.—Elevation of Heated End of Rearer

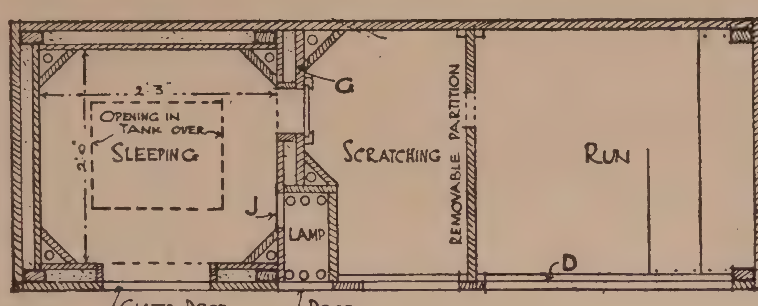


Fig. 26.—Plan of Hot-water Chicken Rearer

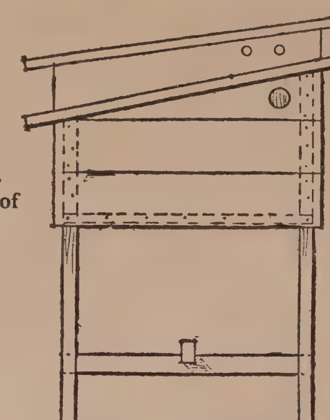


Fig. 27.—Elevation of Run End of Rearer

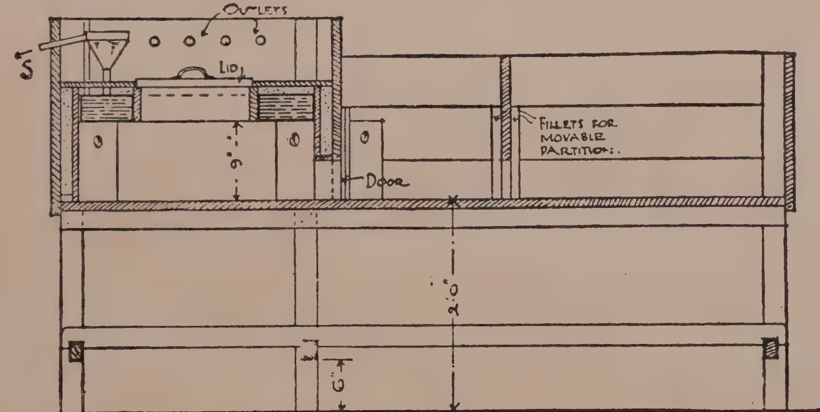


Fig. 30.—Longitudinal Section of Hot-water Chicken Rearer

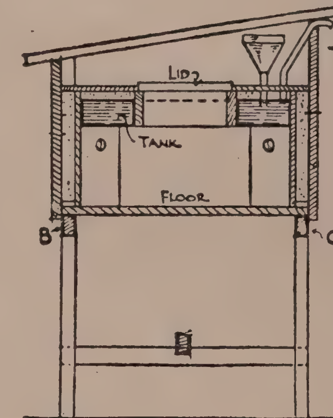
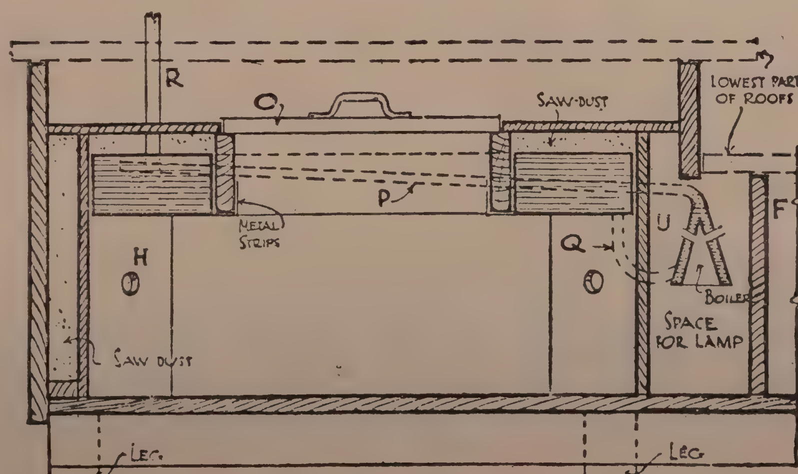


Fig. 28.—Cross Section through Heated End of Rearer



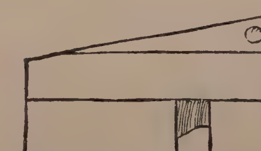


Fig. 29.—Partition across Run

Fig. 31.—Detail Section through Tank, etc., of Rearer

Fig. 24. The movable partition should be made as in Fig. 29, sliding between fillets as in Fig. 30, with a small opening (with sliding door), and a circular vent cut at the top, a similar one being arranged in the end of the run (Fig. 27).

The construction of the roof is intentionally omitted ; but it should be in two portions, each to hinge or take right off, and composed of boarding on ledges either inside or outside the front and back upright boarding, the whole being felted in the usual way.

Dealing next with the sleeping compartment, this should be fitted up with double walls, as shown in Fig. 26, the inner divisions being either ordinary wood, three-ply, or stout millboard, fixed to the necessary small fillets, and the cavities packed with sawdust rather than left empty. There need be no cavity next the lamp space, the division on the right of which should be of thicker boarding. It is carried up to the underside of the sloping roof to the outer compartments as at F in Fig. 31, as is also the division at G in Fig. 26. In this latter a sliding door will be required. Six corners should be cut off with sloping pieces 9 in. high and 6 in. wide, arranged with holes near the top H (Fig. 31) and in the floor, to serve as inlets for fresh air. The corner pieces in the sleeping chamber support the tank. Air inlets to feed the lamp should be bored in the floor of the lamp space at back and front (*see* Fig. 26), as if in the upright front they might allow a draught to extinguish the flame. On the left a piece of glass should be inserted as at J (Fig. 26), to slightly illuminate the sleeping compartment at night. It should be on the side away from the lamp.

In severe weather the sliding door might

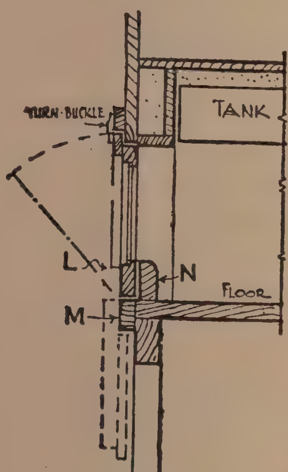


Fig. 33.—Detail Section of Rearer through Door to Sleeping Chamber

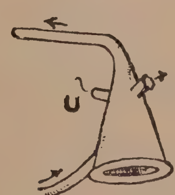


Fig. 34.—Conical Jacket Boiler

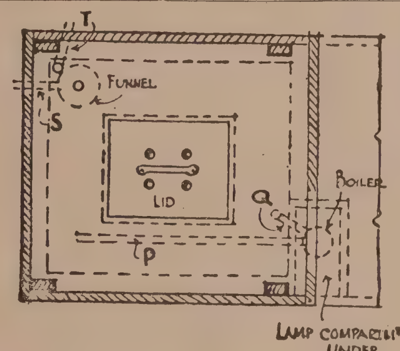
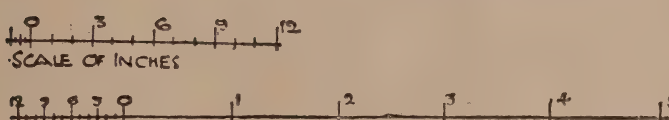


Fig. 32.—Part Plan of Rearer above Tank, etc.



have a piece of baize cut into strips to keep off the cold air when the door is raised, and careful fitting is necessary for the cleaning and observation door K (Fig. 24). This is hinged at the bottom and secured at the top with a turn-buckle or other fastening as shown. It might be made double ; but a good draught-excluding arrangement is explained by the section in Fig. 33. Here the dotted indication of its position when open shows that the fillet mitred round the top and sides (to cover the joint, as in Fig. 24) cannot be taken below the point L, because of the boarding at M. To compen-

sate for this a piece N is fixed across the opening, and rounded slightly at the top. There is nothing special about the door, into which the glass might be puttied. For the lamp space the door need not fit so tightly. It can be arranged flush with the boarding, hinged as before, and should have a small pane of glass inserted, so that the condition of the lamp flame can be seen from without.

The tank is a hollow rectangle, constructed of stout zinc or preferably copper. It measures 2 ft. 3 in. by 2 ft. by 3. in., has a central opening 1 ft. 3 in. by 1 ft., and is boxed in with a top packing of sawdust, a central frame and lid O (Fig. 31), with a handle for lifting, all as before, and as shown by Figs. 28, 30, 31, and 32. Holes as outlets for foul air should be bored in the lid, as in Fig. 32, and the space above (*see* Fig. 28) should be ventilated by means of a series of holes quite near the top (*see* Fig. 30).

Briefly, the heating installation consists first of a conical "jacket boiler" (Fig. 34), seen in section in Fig. 31. The inner cone which is placed over the burner is 2 in. wide at the bottom and $3\frac{1}{2}$ in. high, and the outer one $\frac{1}{2}$ in. wider all round, thus allowing just sufficient space for the water, which as it becomes heated flows along the tube P (Figs. 31 and 32), taken nearly to the top of the tank, and held there with wire, displacing colder water which immediately flows to the boiler via the tube Q, which should have a slight curved drop below the boiler as shown, thus completing the necessary circulation. For filling purposes there is required a tube as at R, taken 1 in. below the top of the tank, fitted with a large funnel, which should always be kept filled in order to ensure that the tank is not running dry. An overflow, as at S in Figs. 30 and 32, is advisable, and an outlet T (Figs. 27 and 32) is essential. This latter should start quite flush with the underside of the top of the tank, and be taken 1 in. above the funnel; it allows the air to escape when the tank is being filled. They both serve to throw escaping water free of the interior. All the tubes employed should be copper and $\frac{1}{2}$ in. in diameter. The woodwork must be cut away for the insertion of the pipes, etc., and made good when the whole has been satisfactorily adjusted. Note that outlets, as at U (Figs. 31 and 34), must be provided for the escape of the products of combustion from the underside of the boiler, and holes cut above the lamp door, as in Fig. 24, for the same purpose.

The lamp might be bought ready made or fitted with a special oil container, rectangular in shape and of the largest possible capacity to suit the space. Those fitted with a rim round the flat top to contain water and thus prevent the oil from overheating are desirable.

The chimneyless burners often used for rearers would not suit this particular case, as the flame would be too confined; but a $\frac{5}{8}$-in. "Queen Anne" type of burner would suit. It should be quite near the bottom of the boiler, and fitted with a glass or preferably mica chimney. To work efficiently it must be cleaned at intervals, especially the gauze perforations, which should be thoroughly brushed. Care is also necessary to see that the inlets and outlets to the lamp space are adequate, as otherwise the flame is sure to become sooty.

A thermometer should be placed about half-way between the centre and one side, and with the bulb about 3 in. above the floor.

Tubs and Churns

WASHING KEELER

A KEELER is a round tub about 2 ft. in diameter, tapering down to 15 in. at the bottom, and about 16 in. or 18 in. deep. It is made specially for use in the washing of clothes.

Anyone who can use tools fairly well can make one of these useful articles quite as easily as he can turn out the washing trough; in fact, it is easier to make the round keeler watertight than it is the oblong trough. Fig. 1 shows a keeler as seen from immediately above, and Fig. 2 is an elevation of the same article. It is made up with a series of taper pieces of wood jointed together and held tightly by four iron hoops. The bottom fits into a channel formed in the tapered pieces (technically "staves"), and provided that the joints are made true the keeler cannot help being watertight. The size of the keeler is governed by the number and width of the staves. For one of the size mentioned above there will be required twenty-four staves 3 in. wide at the top and $\frac{1}{8}$ in. under 2 in. at the bottom. Fig. 3 shows a board 11 in. wide by 6 ft. long with these twenty-four pieces marked on it, ready for cutting out. After cutting out is completed comes the most important part of all, the jointing up of the staves, and this is only difficult as regards the angle to which the edges have to be planed so that they will fit closely when assembled into the perfect circle. This angle can only be found by setting out the number of staves round a circle and drawing radiating lines from the centre. The angle will vary according to the number of staves being used to make up the whole, therefore it is necessary to set out the number correctly. The correct angle for the present example is 9°, and a section of one of the staves with the edges planed to this angle is given by Fig. 4.

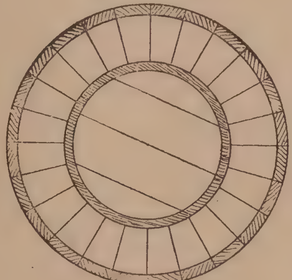


Fig. 1.

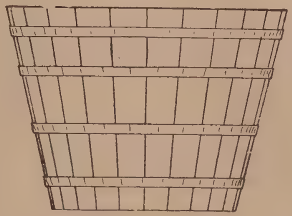


Fig. 2.

Figs. 1 and 2.—Plan and Elevation of Washing Keeler

Extreme accuracy as regards the width of any or all the staves is not necessary, but the correct angle on the edges is essential. After the jointing up is finished each stave must be squared off

at the small end, not squared from one edge but from a centre line, so that the cut-off end is at the same angle from each edge, and from this "squared" end the position of the channel to take the bottom is marked with a gauge. The width of the channel should be about $\frac{3}{8}$ in. It should be V-shaped, and it must be on the narrow side of the stave. One stave with the channel cut is shown by Fig. 5, and an isometrical sketch of the same is shown by Fig. 6. For convenience in putting the keeler together it is as well to insert two short dowels in each joint, and Fig. 6 shows the holes bored for these. Needless to say, these must be made truly as regards distance from the bottom end of the staves, or the dowels will do more harm than good.

The bottom is made up of fairly narrow pieces of wood jointed up truly, the joints dowelled, and the whole cut correctly to the size required. To ascertain this it is as well to put the whole together, and take the actual measurement across the channel; the bottom can then be cut to a true circle, and the edges bevelled off to fit. In this connection it is necessary to remember that the joint should be a close one inside the keeler, and though the angle of the chamfers on the bottom should be the same as those which form the channel, yet it is better to err as shown in Fig. 7 rather than as in Fig. 8; the former would be a passable job, but the latter would not. The complete bottom ready for putting in is shown in plan and section by Figs. 9 and 10 respectively.

The hoops for holding the keeler together are now required. These are made out of ordinary hoop-iron riveted together and made to the correct "dish" by hammering round one edge on an anvil. The correct length for the hoops can best be ascertained by passing a string round the keeler at the places where the hoops are to be fixed, remembering that they will drive up considerably during the act of tightening. The two ends of the hoop-iron punched to take the rivets are shown by Fig. 11, and a section of the joint after riveting by Fig. 12. The heads of the rivets should be on the inside of the hoops so as to avoid as much friction as possible in the driving on. The hoops will now be absolutely straight and parallel, and require hammering round on the inside to form the dish to fit the tapered sides of the keeler. This is given by hammering round the inside as stated above, and has the effect of expanding the iron and bending it edgewise, as in Fig. 13, where the upper illustration shows it straight as originally purchased, and the two other illustrations successive stages as the hammering proceeds. Care must be taken not to overdo it, but to stop when the hoop will just fit the sides of the keeler. In putting together, the upper hoops should be placed in position first, gradually tightening them up until the bottom will just drop in from the inside, when the bottom hoop can be put on and the whole tightened up. The hoops are driven on best by holding a solid piece of iron on them horizontally, and striking this with a hammer; gentle taps and plenty of them is the correct way, rather than any violent hammering, which would only result in a distorted and ugly result.

A section of the finished keeler is shown by Fig. 14, where the ends of the staves both top and bottom are cut off in a straight line across. This can now be done, and will finish the job. By leaving two of the staves at each side of the keeler some 3 in. longer at the top end, and cutting a grip in them, as in Fig. 15, handles are formed for lifting purposes.

Keelers of an oval shape can be formed in the same way, as in Figs. 16 and 17. The former is struck out with the compasses from the square as dotted lines, the latter from a diamond as shown in the same way. The only difference in making the oval and round keelers is, whereas in the latter the staves are all required to be planed to the same angle on the edges in jointing up, the latter must be varied in the angles. There is, however, no difficulty in this, as the joints have to radiate from the centre from which this particular portion is struck; they will then be certain to fit. In like manner the hoops will require to have more "dish" in the quicker curves, otherwise

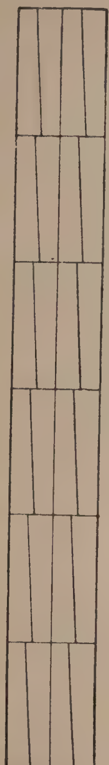


Fig. 3.—Board Marked Out for Staves

Fig. 4.—Section of Stave

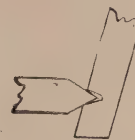


Fig. 7.

Fig. 8.

Figs. 7 and 8.—Bottom Fitted Correctly and Incorrectly

Fig. 5.

Fig. 6.

Figs. 5 and 6.—Stave Channeled for Bottom

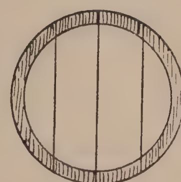


Fig. 9.—Bottom Ready for Putting In

Fig. 10.—Section of Bottom

Fig. 11 —Hoop-iron Punched for Rivets

Fig. 12.—Riveted Joint of Hoop

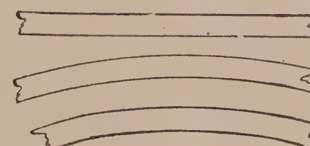


Fig. 13.—Effect of Dishing Hoop-iron

Fig. 14.—Section of Keeler

Fig. 15.—Forming Handles of Keeler

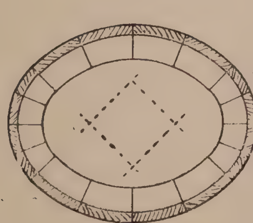


Fig. 16.

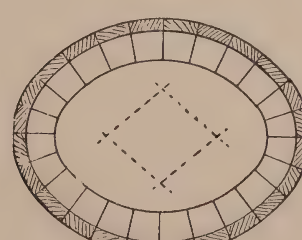


Fig. 17.

Figs. 16 and 17.—Oval Keelers

the making of the oval and the circular is identical.

Deal of good quality is quite suitable for the making of these keelers, but it must be free from knots and shakes; or they may be made of non-resinous sapwood to prevent stain-formation on the clothes to be washed in them. For a keeler of large size use 1-in. wood, but for a small one up to 12 in. in diameter $\frac{3}{4}$-in. stuff will be sufficient.

WOODEN BUCKETS

Wooden buckets are constructed in practically the same manner as the keeler just described. In the first place it is advisable to make full-size working drawings similar to Figs. 18, 19, and 20. The dimensions are a matter of individual requirements, but a medium-size bucket would be about 12 in. high and 12 in. in diameter at the top, with a bottom diameter of 10 in. and staves $\frac{5}{8}$ in. thick. The staves should not exceed 3 in. in width at their tops, and lines drawn from the centre, as in Fig. 19, give the correct angle for the joints of the staves. Any kind of wood can be used providing it is well seasoned and free from knots and sap. The number of staves required should be set out with a pair of compasses round the greatest diameter at the top. These can now be finished to size and section, as in Fig. 19. Templates should be made of the end sections of the staves at the top and bottom, as in Fig. 18, and applied to the staves after they have been wrought to size, and bevelled for joints, as in Fig. 19. The outsides of the staves are easily wrought to the required diameters, but their insides present a difficulty which can be got over by using suitable round-sole planes.

To produce the three hoops of the correct shape lay out on a large board or floor the shape of the bucket, as shown in Fig. 21; draw the centre line, and produce the sides until they meet in point A. Then with A as centre and B and C as radii, describe two arcs of circles as shown by dotted lines, and repeat for each hoop. This will give the correct shape of the hoop-iron when flat. The length required for the hoop will be three and one-seventh times the diameter of the tub at the place where the hoop is to go, with the addition of 2 in. for a lap joint. Take a piece of hoop-iron of this required length, lay it flat

Fig. 18.—Plan of Wooden Bucket

Fig. 19.

Fig. 20.

Figs. 19 and 20.—Method of Laying-out Wooden Bucket

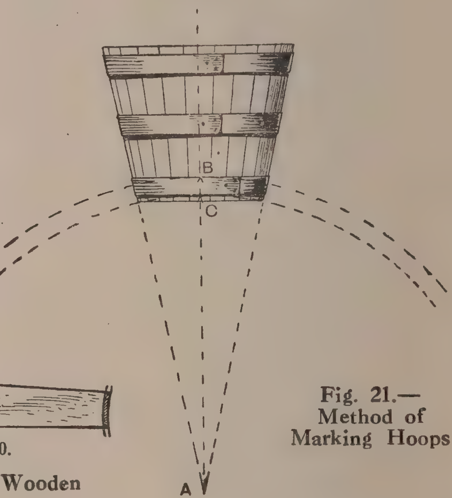


Fig. 21.—Method of Marking Hoops

on an anvil or iron weight, and hammer it with even blows along one edge, when it will be found to curve away from the hammered edge. Turn over and hammer on the other flat to prevent curling up, and apply frequently to the curve until it is of the required shape. Then bend round the bucket, pinch and rivet the joint, and the hoop will be ready to drive on.

The instructions given for assembling the keeler are equally applicable in the case of a bucket, and therefore need not be repeated other than to point out that the pinching process must be well done.

SMALL BUTTER CHURN

A simple household churn that will make ½ lb. of butter at a time, taking for the operation ten minutes, is shown by Fig. 22.

The container is an ordinary preserved-plum jar about 6¼ in. by 3¾ in. Of course, any vessel of similar size may be used, and earthenware or tin might be employed, but a glass bottle is much the best, as the process may be watched. The bottom portion of the dasher (below the collar) should be groovcd out to fit the dasher blades, ¼ in. deep; the grooves should be

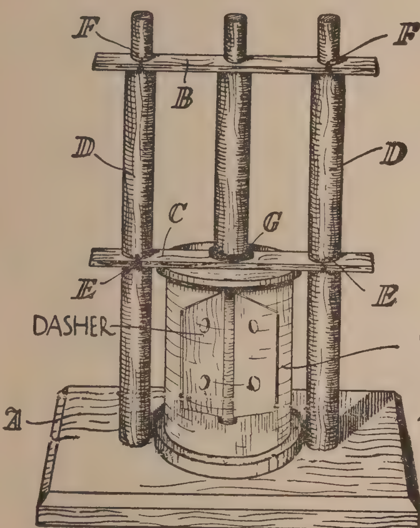


Fig. 22.—Small Butter Churn

Fig. 27.—Blade

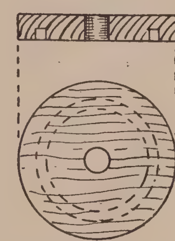


Fig. 26.—Plan and Section of Container Cover

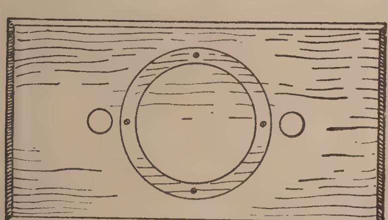
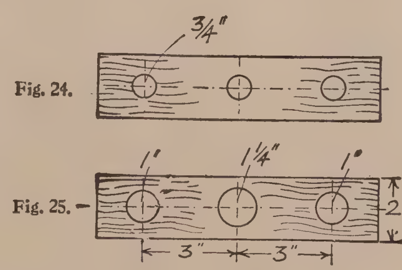


Fig. 23.—Base of Small Butter Churn



Figs. 24 and 25.—Top and Cover Fasteners

a fit with the dasher blades, so that when wetted and swelled they are fixed tight. When the dasher is ready, slip the container cover on from the bottom (the hole in the cover is $\frac{3}{4}$ in.), slide the dasher blades into their grooves, and drop the whole into water for an hour, when the blades will be found quite tight. The base A is 1 ft. long, $6\frac{1}{2}$ in. wide, and 1 in. thick, with a $\frac{3}{4}$-in. projecting ring $3\frac{7}{8}$ in. internal diameter (*see* Fig. 23). The top fastener B (Fig. 22) and cover fastener C (*see* Figs. 24 and 25) are $\frac{3}{8}$ in. thick. The standards D (Fig. 22) are 1 in. in diameter and 1 ft. long, exclusive of 1-in. ends $\frac{3}{4}$ in. in diameter, with a hole in the centre of each for pins E, and others in $\frac{3}{4}$-in. ends for the pins F. These pins are made from No. 16 B.W.G. brass wire, 3 in. long, exclusive of the head. Fig. 26 shows a plan and section of the container cover. It is 1 in. thick and 5 in. in outer diameter, with a $\frac{1}{4}$-in. groove, $\frac{1}{2}$ in. from the edge, and a central $\frac{3}{4}$-in. hole.

The dasher has three blades, $1\frac{1}{4}$ in. wide, 4 in. maximum and 3 in. minimum length, and $\frac{1}{2}$-in. holes. Fig. 27 shows the shape of one of the blades. The centre spindle is 1 in. in diameter at the top, with a $\frac{1}{8}$-in. pin 1 in. long, the diameter of the spindle being reduced to $\frac{3}{4}$ in. for the blades. The collar G (Fig. 22) is 1 in. thick and $1\frac{1}{4}$ in. in diameter.

To use the machine, slip the container into the bottom ring (*see* Fig. 23), fill it three-quarters full with cream, put in the dasher, fix the cover on the bottle, slide the cover fastener on from the top, and fix it hard down on the cover by means of the two pins, which should fit tight into the holes in the standard just level with the top of the cover. Now slide on the top fastener and fix it similarly with two pins, fasten the churn by a clamp to a

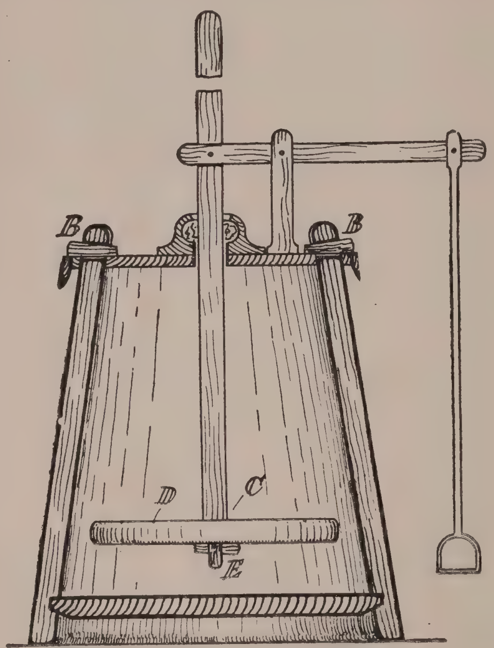


Fig. 28.—Foot-operated Butter Churn

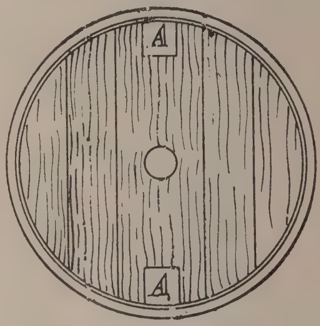


Fig. 29.—Plan of Lid

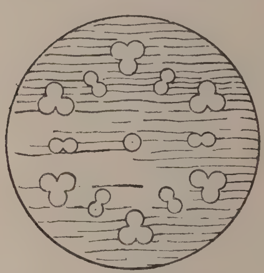


Fig. 30.—Plan of Dasher

table top, take half a dozen turns with string round the dasher stem above the collar, and pull it sharply to and fro. To prevent losing the pins they should be fastened to the standards by means of small staples and strings.

The woodwork should be teak, which will stand the wetting and drying, and does not taint the butter.

FOOT-OPERATED BUTTER CHURN

An upright churn that can be worked by the foot is shown by Fig. 28. It is made like an ordinary straight tub, the bottom being perfectly level inside—that is, the usual bevel is taken from the outside only. Two of the staves, exactly opposite each other, project 4 in. above the others at the top, passing through a mortise hole A (Fig. 29) cut in the lid, also being themselves mortised to allow of a wedge B (Fig. 28) being inserted to keep the lid in position. A kind of packing-box is fastened on the lid, in the hollow cavity of which a cloth is packed during the operation of churning to prevent splashing and leakage. The upright shaft has a shoulder C turned on its bottom end (Fig. 28), against which the dasher D (Fig. 28) is fixed by a wedge E passing through the lower end of the shaft. Trefoil holes, $\frac{3}{4}$ in. in diameter, are bored in the dasher (Fig. 30). The dasher should be made in one piece if possible. The lid (*see* Fig. 29) may be made in several pieces, pegged together and placed tightly inside a wooden hoop and secured with screws.

The butter is produced by alternately raising and lowering the central shaft in quick succession.

The churn may be made of 1-in. oak, teak, or ash.

Doors and Windows

DOORS

Ledged and Battened Doors.—The simplest type of door is the ledged and battened door as shown in Fig. 1. The boards or battens should be tongued, grooved and beaded, or V-jointed.

It is usual to select the boards so that the width will build up to the required size. In Fig. 1 six 6½-in. boards are suitable. Cut the boards to length and cramp together. Measure the surplus width and divide it between the two outside boards. Cut away the surplus width. If the boards are not a convenient width, it may be necessary to make each board narrower and re-plough the groove to receive the tongue.

Prepare the ledges as shown. The top ledge is suitable for inside work, the middle and bottom ledge show two methods for outside work, the latter being better because the throating throws off the water.

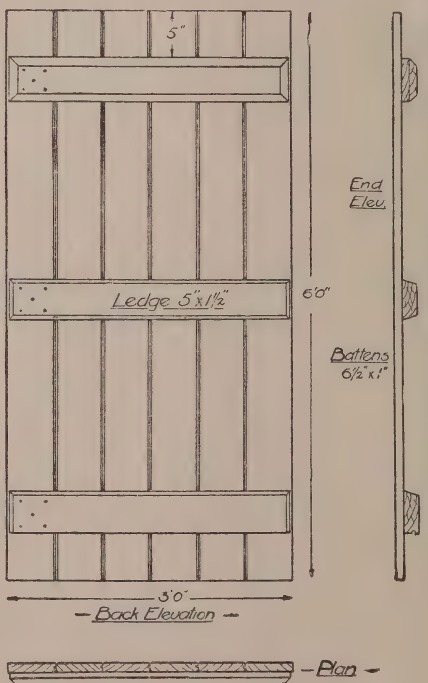


Fig. 1.—Elevation, Section and Plan of Ledged Door

Construction.—Take one of the outside boards and mark on the back the positions for the ledges. Nail on the ledges firmly, taking care to have them at right angles to the edge.

Turn the ledges and board over so that the ledges lie flat and "out of twist" on the bench. Place the remaining boards in position and cramp up. Rule pencil lines where the nails are required. Nail every board securely and punch the nails.

Screws in the outside boards prevent them curling off, and paint should be applied between the ledges and boards.

Ledged and Braced Door.—This door (Fig. 2) is similar to the previous one with the addition of the braces, which prevent the door from

dropping at the outer edge and rubbing on the floor.

The simplest method is to make the door exactly as Fig. 1, and then " let in " the braces ; these must be placed so that 3 in. away from the end of the ledge or the portion receiving the thrust will shear off.

Framed and Ledged Doors.—This makes an excellent door for hard wear.

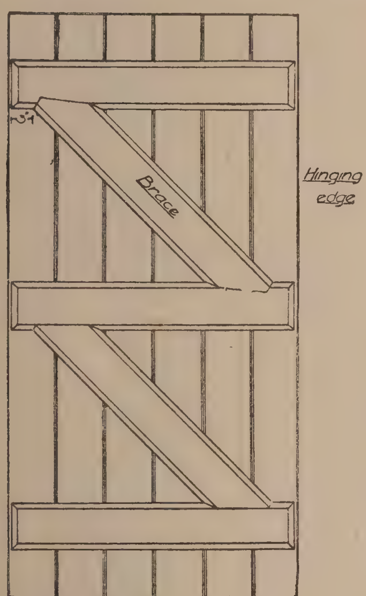


Fig. 2.—Elevation of Ledged and Braced Door

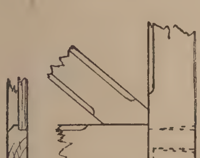


Fig. 3.—Joints of Framed and Ledged Door

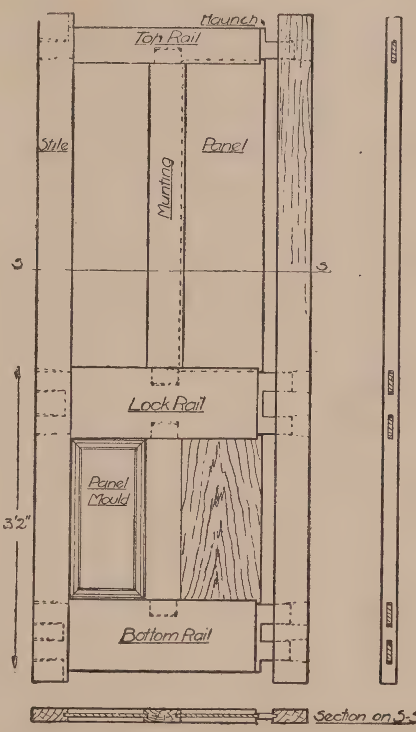


Fig. 4.—Front and Side Elevations and Horizontal Cross Section of Simple Panelled Door, showing method of fitting together

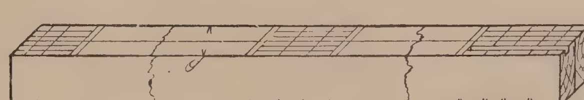


Fig. 5.—Setting Out Stiles

the bottom end is on the same side as the hinge.

The chamfers on the ledges and braces will require mitreing where they meet. Two ways of letting in the braces are shown. Keep the end of the brace about

It consists of stiles, head, ledges and boards. The stiles and head are equal in thickness to the ledges and boards together.

The ledges and head are tenoned into the stiles and the head is rebated for the

boards, which run from the head to the floor line (*see* Fig. 3).

It is better to stop-chamfer the stiles, and run the chamfer through on the rail and ledges. The boards are flush with the stiles and head on the face side, and all the members of the framing are flush on the back.

The stiles are sometimes rebated for the boards, but generally grooved to receive the tongue. Very often the width of the boards available decides which method is to be used.

Braces may be added if required. It is then advisable to stop-chamfer all the members of the framing as shown.

Panelled Doors.—These consist of framing which is grooved, and panels of thinner material inserted, or the groove may be formed by planting beads as for glass.

The variety and style depend upon the individual ideas of the designer, but the principles of construction are similar in most cases. Fig. 4 shows the simplest form of panelled door, with one stile partly removed to show the construction. The names of the various members are shown on the drawing. The following is a table of approximate sizes for a 6 ft. 8 in. by 2 ft. 8 in. by $1\frac{1}{2}$ in. door.

CUTTING LIST

Material	*Length*	*Breadth*	*Thickness*
2 Stiles	6′ 10″	$4\frac{1}{2}$″	$1\frac{1}{2}$″
1 Munting	3′ 6″	$4\frac{1}{2}$″	$1\frac{1}{2}$″
1 ,,	2′ 0″	$4\frac{1}{2}$″	$1\frac{1}{2}$″
1 Top rail	2′ $8\frac{1}{2}$″	$4\frac{1}{2}$″	$1\frac{1}{2}$″
1 Lock ,,	2′ $8\frac{1}{2}$″	9″	$1\frac{1}{2}$″
1 Bottom ,,	2′ $8\frac{1}{2}$″	9″	$1\frac{1}{2}$″
2 Panels	3′ 4″	11″	$\frac{1}{2}$″
2 ,,	1′ 10″	11″	$\frac{1}{2}$″
Panel Mould	54′ 0	$1\frac{1}{2}$″	$\frac{1}{2}$″

The extra length on the stiles is to provide horns, to protect the corners until the door is hung.

Setting Out.—Set out one stile, marking the position of the rails and mortises on the face edge. Square the mortises over to the back edge and allow for wedge room. Note that the mortises are the depth of the panel groove from the inside edges.

Place the two stiles together, with face sides on the outside and the face edges together, thus pairing them. It is necessary to pair the stiles, etc., in all framing. Square all the marks on to the second stile (Fig. 5). Set the mortise gauge so that the mortise is one-third the thickness of the material, and in the middle; then gauge all the mortises from the face side.

In all the preparation and assembling, work from the face side. Next set out the rails. First set out one rail and then transfer to the others as with the stiles. Allow $\frac{1}{8}$ in. over the finished width for cleaning up the edges. The muntings are set out from the stiles.

Prepare all the mortises and tenons, and groove the edges for the panels $\frac{7}{16}$ in. deep. Also plough a piece of waste stuff for a mullet; this is to test the panels for thickness, as shown in the chapter on planing.

Haunches are necessary on the outer edges of top and bottom rails to allow for wedging the rails; also between the tenons on the wide rails. These haunches are equal in length to the depth of the panel groove less $\frac{1}{16}$ in.

Prepare the panels, allowing $\frac{1}{16}$ in. clearance all round. Common sense must be used if the material is not seasoned, and allowance made for shrinkage.

To assemble the parts, when prepared, and everything has been fitted, commence with the lock rail and muntings, place the panels in position, then the head and bottom rails, and lastly the stiles.

Prepare a level surface on the bench for cramping up, to prevent the door from being twisted when finished. When the joints are satisfactory, knock the stiles partly off (*see* Fig. 4). Glue the tenons and drive the stiles back. Cramp up quickly, glue and drive in the wedges. Avoid any glue getting on to the panels, as they must be free to expand or contract. The top rail is wedged down and the bottom rail up, to tighten the joints between muntings and rails. Clean off, smooth and sandpaper.

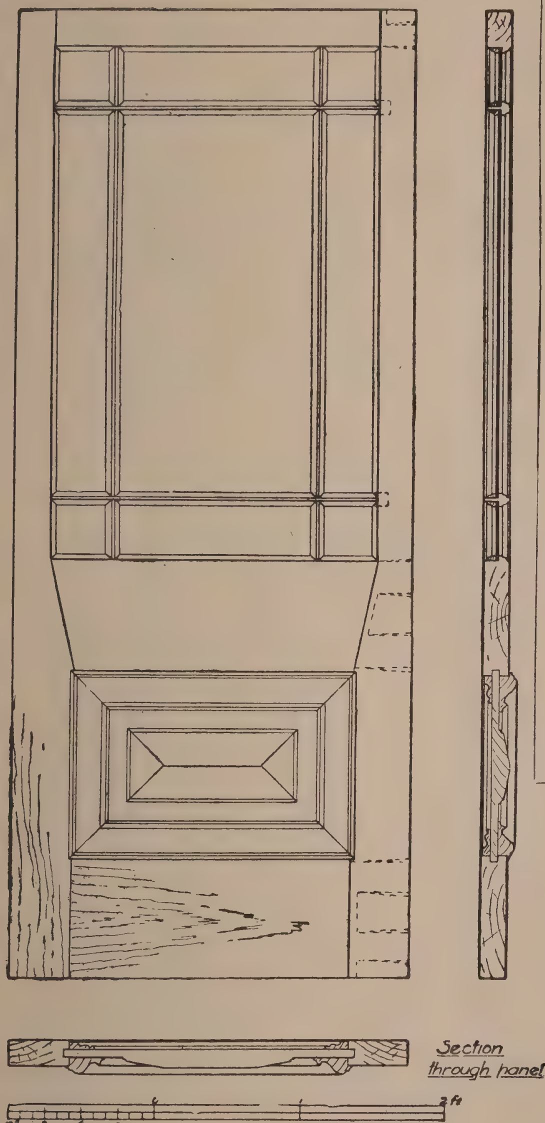


Fig. 6.—Front Elevation and Vertical and Horizontal Sections of Door with Diminished Stiles

The panel moulds must be nailed to stiles and rails only otherwise the nails will fix the panels.

Take the sharp corners off the panels and tenons before assembling. The bottom panel (Fig. 4) shows the correct way to arrange the grain. Fig. 4 shows how to set out and gauge the stiles, also one stile prepared for the bottom rail. The panel groove is omitted for clearness.

Doors with Diminished or "Gun-stock" Stiles.—The upper panels of these doors are of glass. The intention is to provide the maximum of lighting; also it allows more scope for ornamentation and design, and often this is the only reason for its adoption. Fig. 6 shows a familiar type. The material is prepared as for the previous door. In setting out the difficulty is with the joint between the lock rail and the stile.

Set out the stiles as shown in Fig. 7. The diminishing takes

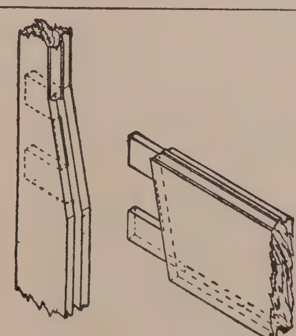


Fig. 8A.—Joint of Lock Rail to Stile

Fig. 7.—Setting Out Diminished Stile

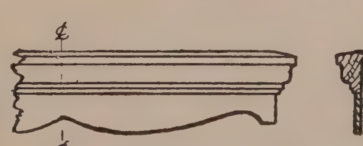


Fig. 8.—Apron Mould

place in the width of the lock rail, less the mould. It is important to guard against error, as it is impossible to rectify a mistake without making the door narrower. Fig. 7 shows clearly what is required, also the construction.

If the mould is planted on after the door is finished, the work is simplified throughout.

Leave the preparation of the bars until later. The door is usually allowed to

It is usual to scribe the lock rail on to the stile to allow for shrinkage (*see* Fig. 7). The raised panel entails a lot of labour, unless the raised portion is planted on and screwed from the back.

The bolection moulds are often built up in panels, by slips and screws, before placing in position; this prevents the mitres from opening. Generally the moulds are driven in tightly and slot-screwed from the back of the panel, to

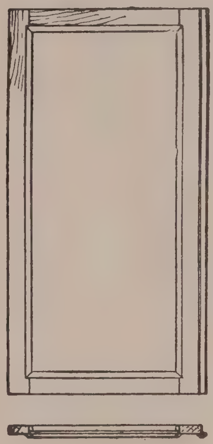


Fig. 9.—Elevation and Cross Section of Plain Bookcase Door

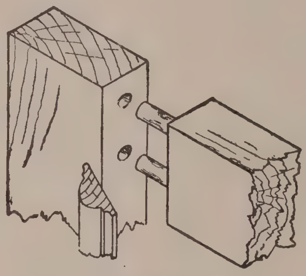


Fig. 11.—Dowel Joint

Fig. 10.—Elevation and Cross Section of Barred Door

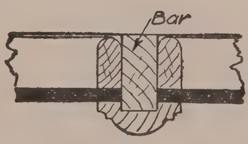


Fig. 12.—Section through Bar

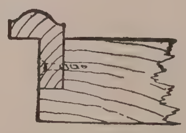


Fig. 13.—Joint on Closing Stile

stand, after framing together, for further seasoning, so that it is useless to fit the joints and prepare the bars until it is intended to wedge up.

The bars should be halved where they cross, and tenoned at the joints; the thickness of the tenon depends upon the form of the mould. The horizontal bars should run through on the rebate side. The mould on the bars should be mitred with the rails and stiles. In machine joinery they are scribed.

allow for expansion or contraction of the panel. The panel mould at the back covers up the screws.

An apron mould (Fig. 8) can be placed on the lock rail if desired; its length is equal to the lock rail (*see* Fig. 8A).

Bookcase Doors.—This type of door comes under the heading of cabinet-making rather than joinery, and the construction differs slightly from the preceding doors, owing to the lightness and delicacy required.

Two examples are shown (Figs. 9 and 10). One is extremely simple in construction, and the other of the type known as a barred door, used in Chippendale and similar styles.

The rails may be joined to the stiles by the ordinary mortise-and-tenon joint, a stump tenon with fox wedges, or by dowels (Fig. 11). The latter is generally adopted by the cabinet-maker. The rebate for the glass is formed by planting the mould on the face of the door (Fig. 11).

In the barred door (Fig. 10), the bars are formed in two parts, the bar itself being formed of rectangular pieces, and the mould being planted in afterwards. It is grooved on to the bars and held in position by glue (Fig. 12).

It is necessary to set out a portion of the door to full size and work from the drawing. The bars are halved together where they cross. In delicate work, narrow tape is glued on the back to strengthen the joints. For the stiles and rails, half the mould is planted on. Fig. 13 shows the best method of forming the joint on the closing stiles.

In a large amount of cabinet-work the ornamentation is laid on to the face of the glass. This cuts out a lot of labour, but entails much work if the glass is broken. If curved ornamentation is used, the curved portions are steamed and bent on a saddle to the required shape. Such steaming is best undertaken by a firm equipped with a steam-chest.

Fig. 14.—Elevation of Door Casings

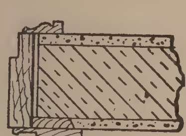


Fig. 15.—Section through Stile of Door Casings

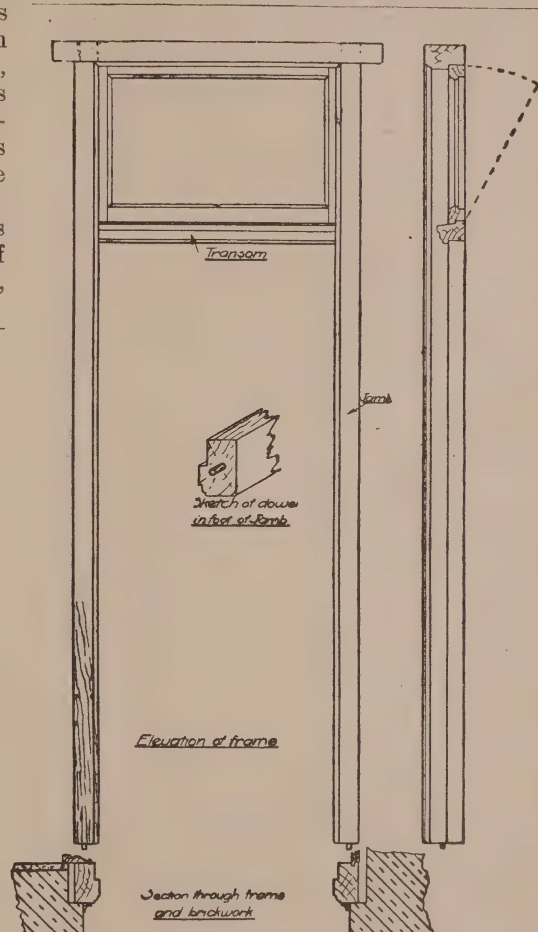


Fig. 16.—Front and Side Elevations and Sections of Door Frame

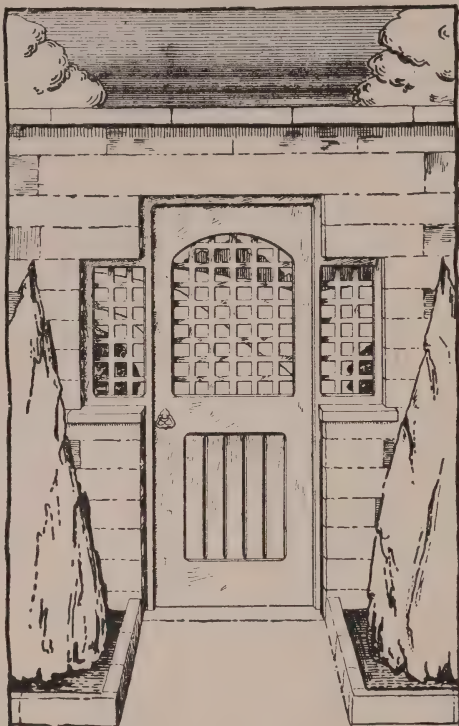


Fig. 17.—Trellised Garden Door

DOOR FRAMES

The form of a door frame depends upon the position in which it is placed. Fig. 14 is a common type used for inside work. It is formed of 6-in. by $1\frac{1}{2}$-in. casing stuff, which is stocked by most builders. The section Fig. 15 shows the method of fixing for a $4\frac{3}{4}$-in. wall. The wall is plugged and the casings nailed to the plugs. For better-class work, grounds are fixed to the brickwork (as shown), and the woodwork fixed to the grounds.

The stiles are housed into the head to the depth of the rebate. The horizontal and diagonal stays are to keep the casings square until they are fixed.

If the wall is more than $4\frac{1}{2}$ in. thick, the width is made up by wood linings or by plaster. In good work the width of the casings is increased, and often framed and moulded panels are formed.

Frame for External Door.—For outside walls a much stronger frame is required, such as Fig. 16. It is formed of about 5 in. by 3 in.

In construction the stiles or jambs are tenoned into the head, which projects at each end to build into the wall in new work. The transom is shown prepared for an opening light. The fixing is done by wedging at the top and transom and by iron dowels driven into the foot of the jamb (Fig. 16). These dowels fit into corresponding holes drilled in the stone or concrete. The sectional plan shows the method of finishing for a 9-in. wall, and also for a thicker wall.

Garden Door.—The garden door shown in Fig. 17 is both simple and effec-

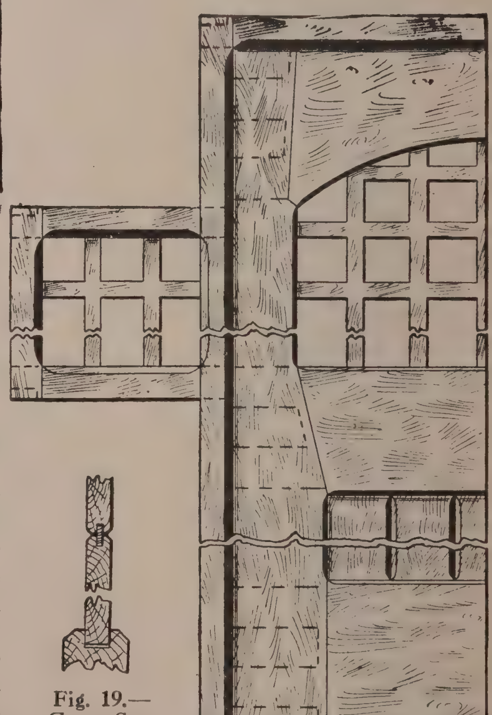


Fig. 19.—Cross Section of Part of Panelling

Fig. 18.—Details of Construction of Garden Door

tive, and is especially suitable for reproduction in oak. The framework is framed up with an opening on each side of the door; the door is framed together, and the lower portion is panelled, while the upper portion of the door and the openings at the sides are filled with an open trelliswork. It is suggested that the opening for the door be 7 ft. high by 3 ft. wide, and the openings at the sides 2 ft. 6 in. high by 1 ft. wide, and 3 ft. 6 in. above the ground level.

The door framework is $3\frac{1}{2}$ in. by $2\frac{1}{2}$ in., framed together with mortise-and-tenon joints; it is rebated to receive the door and the edges are stop-chamfered. The trelliswork at the sides is composed of bars 1 in. square in section, which are half lapped together and stump-tenoned in position. The door consists of two stiles and three rails. The stiles are 4 in. wide at the top, increasing to 6 in. in width at the bottom, by $1\frac{1}{2}$ in. thick; the top rail is 10 in. deep at the ends and 6 in. deep in the middle by $1\frac{1}{2}$ in. thick; the middle rail is 8 in. deep by $1\frac{1}{2}$ in. thick, and the bottom rail is 10 in. deep by $1\frac{1}{2}$ in. thick. The rails are tenoned into the stiles with joints similar to those indicated in Fig. 18. The panelling at the bottom is $\frac{1}{2}$ in. thick, and is in about five portions. The edges of each portion are slightly chamfered, and are tongued together, as shown by Fig. 19, and the panelling is rebated into the edges of the door frame as shown in the same illustration. The trelliswork at the top is made up in a similar manner as that in the openings at the sides, and the edges of the door framework are slightly chamfered.

The door should be hung with three 3-in. butt hinges or with a pair of long flap wrought-iron hinges, and a suitable lock and handle should also be fitted.

WINDOWS

Windows are primarily intended to give light, but, in addition, it is nearly always necessary to arrange for ventilation, and sometimes for ornamentation. Very little guidance can be given with regard to the position or size, other than what may be found in any Local Bye Laws. It must be remembered, in designing, that there is a minimum size, dependant upon the size of the room in which the window is placed. Only the types of window which the average woodworker and amateur are likely to have to contend are dealt with here.

Fast-Sheet Windows.—Fig 20 shows in elevation and vertical section a fast sheet, such as is used in positions where ventilation is not required or has been otherwise provided for. The material generally used is known as sash stuff and may be obtained ready prepared to the following sizes, 3 in. by 2 in., 2 in. by 2 in. and 2 in. by 1 in. bar stuff, the latter being moulded and rebated on both sides. Very often thicker stuff, or a special mould, is required, in which case it is necessary to prepare the stuff in the ordinary way as explained in the section on doors.

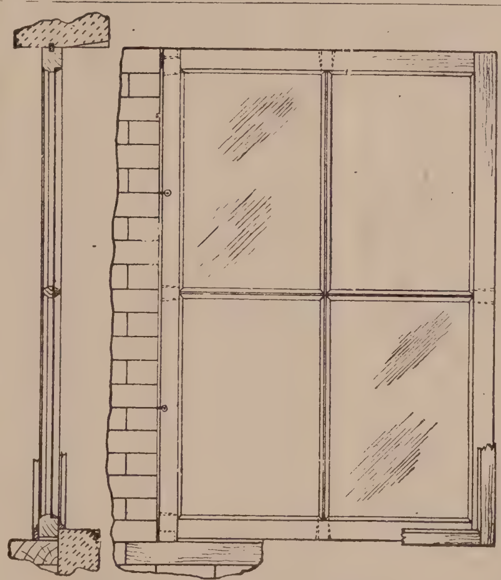


Fig. 20.—Section and Elevation of Fixed-sash Windows

Also, the bar stuff is often considered too thin, and 2 in. by 2 in. substituted and moulded on both sides.

The drawing shows the window fixed in position, with a portion of the linings on the inside, and the scotia on the outside. The window is divided into squares according to the size of glass required. The reason for having small squares is to diminish the cost of breakages, but it will be understood that the inclusion of bars adds very much to the labour of making. The stiles are mortised for the rails and bars. The mortise is not necessarily in the middle of the stuff, but depends upon the moulding. It should be placed on the square of the mould. The usual form is shown in Fig. 21, which also shows the method of making the joint between rail and stile. The dots show the easier method when making by hand, and it will be observed that instead of the mould being scribed through, only a small portion is scribed and the shoulder is left square; therefore the haunch is on the stile instead of on the rail. If the stiles are 3 in. or more the usual haunch may be used exactly as described for the top rail in making a gunstock door. If there are several bars it is better to put them together by halved joints and mitre the moulding. The horizontal bar should run through on the rebate side, otherwise the rebate will probably break off.

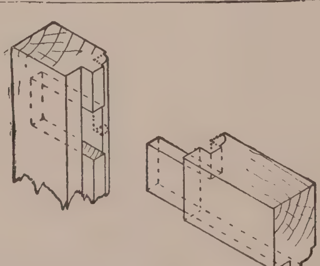


Fig. 21.—Detail of Joint between Stile and Rail

The window is fixed by means of the wedges at the top and bottom, and by holdfasts up the sides. An oak lath about 1 in. by $\frac{1}{2}$ in. is shown in the sill, bedded in white-lead and oil. This preserves the wood. The linings may be mitred at the angles, but the usual method is as

Fig. 22.—Elevation, Section and Plan of Pantry Window

shown. The scotia is mitred on the outside. If the window is beaded for the glass, then the mould is placed on the outside of the window, as this obviates the difficulty of glazing the windows from the outside. When the mould has to stand the weather, the horizontal members should have the top edge bevelled instead of moulded to throw off the water. The tenons on the bars should run through the stiles and rails, then the bars can be straightened when wedging up. When driving in the wedges cast the eye along the bar and tap the wedges to keep the bar straight until it is all right, then drive in the wedges tightly. For outside windows use paint when putting together, for inside windows use glue.

Pantry Windows.—Fig. 22 shows a small window, with top portion opening

for ventilation, generally called a pantry window. The same type of window, but much larger, is generally used in mills and warehouses. The construction is the same as for the fixed sheet, but the stiles are slot mortised for the head, so that when the sash is hung, or pivoted, the head is regulated to the correct position, and then pinned instead of wedged. The transom is rebated on the top edge for the sash, and the stiles, above the transom, have the mould taken off. The sash is pivoted, very often by an ordinary screw at each side, and opened by a length of picture cord which is attached to eyes in the top and bottom rail of sash. Pivots must be used for larger sashes. The pivots or screws must be slightly above the centre and then the sash will close of its own accord. This method gives an open joint between the window stile and sash stile. If this is objected to, it is necessary to have rebates; then it is easier to hinge the sash to the transom and open with a quadrant or fanlight opener. The same general principles of construction apply to any size of window, the only difference being the addition of bars.

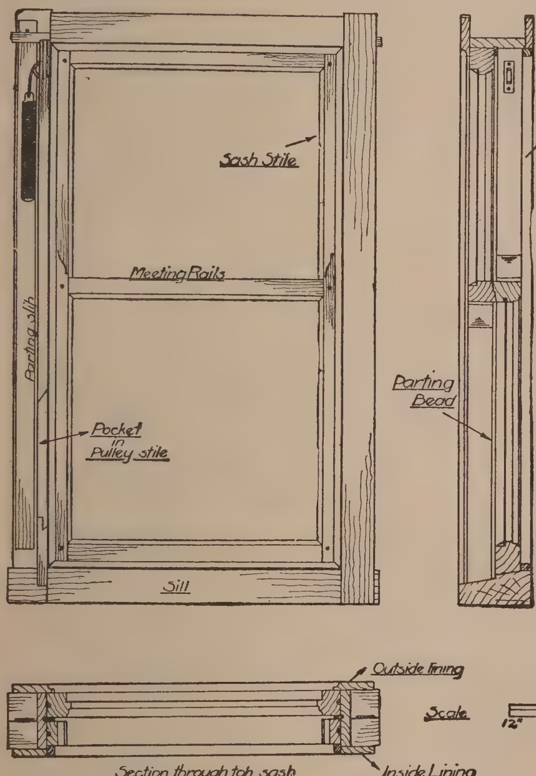


Fig. 23.—Elevation, Section and Plan of Sash and Frame Window

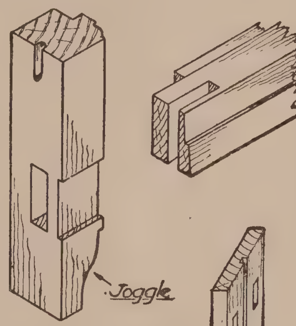


Fig. 25.—Joint between Stile and Meeting Rail

Fig. 24. — Pulley Stile with Pocket Removed

Sash and Frame Windows.—Fig. 23 gives the details for a sash and frame window of the simplest form such as is usually found in cottage property. The window consists of a built-up frame and two sashes which slide up and down. The sashes are

balanced by means of weights attached to the sashes by pieces of cord which pass over pulleys let into the sides of the frame.

The weights run in boxes formed at the sides of the frame, and the two weights to each sash should together approximately equal the weight of the sash. In order to ensure that the sashes keep in position, the weights of the bottom sash should be a little lighter than the sash, and those of the top sash a little heavier.

The frame should be constructed first. This consists of sill, $5\frac{3}{4}$ in. by 3 in.; pulley stiles and head, $4\frac{1}{2}$ in. by $\frac{7}{8}$ in.; outside linings, about $3\frac{1}{2}$ in. by $\frac{5}{8}$ in.; inside linings, $\frac{5}{8}$ in. narrower than the outside linings; guard-beads, $\frac{7}{8}$ in. by $\frac{5}{8}$ in.; parting beads, $\frac{7}{8}$ in. by $\frac{3}{8}$ in. or $\frac{5}{16}$ in. The above are finished sizes. It is usual to have parting slips to separate the weights; these are rough pieces about $1\frac{1}{2}$ in. by $\frac{5}{16}$ in., hanging loosely from the head to within a few inches of the sill. Also, back linings are nailed on the back edges of the linings to keep the boxes free from mortar, etc. The sill is trenched to receive the pulley stiles, which are wedged and nailed; it is also shouldered to receive the outside and inside linings, which finish flush with the sill. The head is trenched about $\frac{1}{4}$ in. deep, to receive the stiles, and secured by nails. A slot is also made at each end to receive the parting slips. The stiles are cut square to the necessary length and then prepared for the pocket pieces. Fig. 24 shows one method of preparing the pockets, but there are many ways in which this may be done. The pockets must be large enough to put the weights through. To prepare the pocket, as shown in Fig 24, commence with the bottom, and cut in half the thickness from the front with the sash chisel. Note that the cut is bevelled inwards. Then turn over and saw as deeply as possible to half the thickness with a dovetail saw, and finish off with the sash chisel. Saw down the groove for the parting bead with a pad saw, and then make the bevelled cut at the top with a dovetail saw. The top is then forced out until the pocket splits off at the bottom, when it is replaced, screwed in position and cleaned off with the smoothing plane. The sash chisel, which has a very thin and wide blade, should be dipped in water before using.

The pulleys must be let in on the centre line of the sash run, and about 3 in. from the top of the stile. Mortise for the body of the pulley and then let in the plate flush with the face of the stile. Everything is now ready to assemble. Commence with the sill and stiles. Wedge and nail the stiles firmly, taking care to have them out of twist, then put on the head. Lay the frame on a level surface, square, and fix temporarily. Then nail on the inside linings, avoiding nailing into the pockets. Turn the frame over, test again for squareness, and put on the outside linings. These project $\frac{5}{8}$ in. inside for the sash to run against. If they are moulded it is necessary to mitre for the mould. Make a gauge for the $\frac{5}{8}$-in. projection and use it whilst nailing on the linings.

The sashes present no difficulties, except at the meeting or middle rails, and Fig. 25 shows the method of making the joint. The rails are $\frac{5}{16}$ in. (the thickness of the parting bead) thicker than the rest of the sash. This increased thickness should be rebated as shown, to exclude the dust, etc., and to prevent the sash fastener being opened from the outside. The sash is much stronger if provided with joggles and also looks better in appearance.

The stiles are mortised in the ordinary way, and, in addition, are cut out about $\frac{3}{16}$ in., to receive a corresponding portion of the meeting rail, as shown in Fig. 25. Care should be taken that the wrong side of the stile is not cut out. For the top and bottom rail proceed in the ordinary way, as shown in Fig. 21. Wedge up and pin the sashes, clean off, then plough the groove for the sashcord, about two-thirds the length of the stile, as shown in Fig. 25. Fit the sashes into the frame, and at the same time put in the parting and guard-beads.

The sashes are hung, of course, after the frame is fixed, and the sashes glazed. They should be weighed after glazing in order to find what weights are required. Take out the beads and pockets. A " mouse " is necessary (this is a piece of

chain, lead or even a nail, bent to go through the pulley and attached to a piece of twine). Tie the twine to the sashcord, pass the mouse over the pulley, take hold of the mouse through the pocket, and draw the cord through. Then attach the weight securely, and pull the cord outside, until into position. This is a usual source of trouble at first. Replace the beads for completion. Special nails known as clout nails are used for nailing on the cords. Fig. 24 shows the pulley stile mortised for the pulleys and with the pocket removed. Fig. 25 shows the joint between the meet-

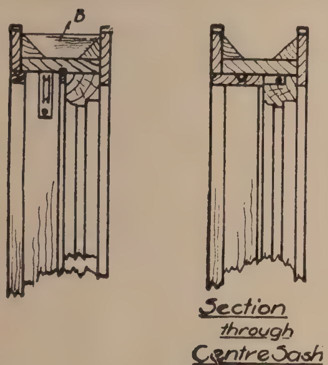


Fig. 28.—Part Section of Top of Mullion through Fixed Sheet

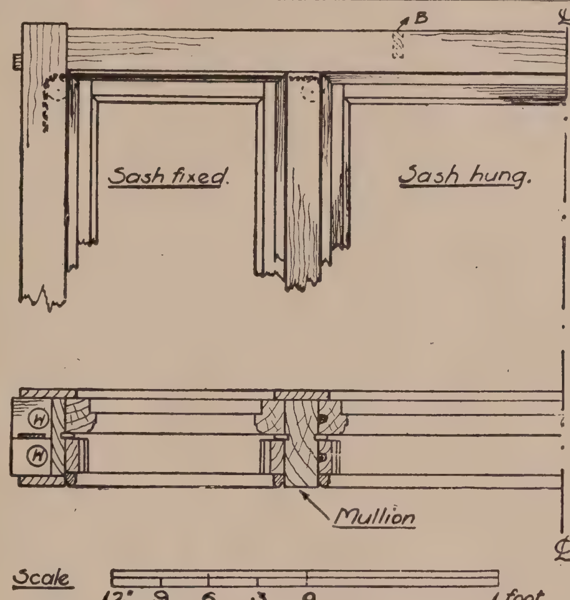


Fig. 26.—Part Section, Elevation and Plan of Mullion Window

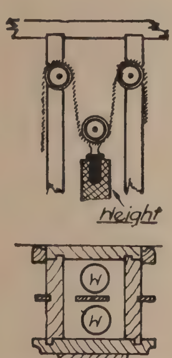


Fig. 29.—Arrangement for Single Weight

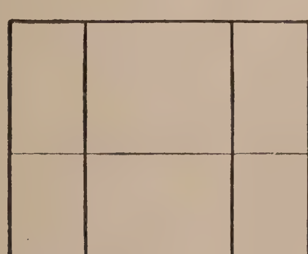


Fig 30.—Diagram showing Proportions

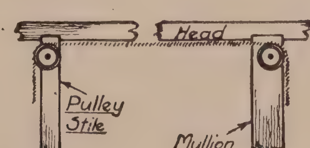


Fig. 27.—Position of Pulleys and Cords

the weight is near the top of the box, and temporarily nail the cord in this position to the frame. When all the cords are in position they may be cut to the correct lengths and nailed to the sides of the sashes. See that the cords for the bottom sash are long enough and the top cords short enough for the sashes to go ing rail and stile, also the method of preparing the joggle and the groove for the cord.

It is necessary to draw the section and plan to full size, otherwise it is impossible to set out the stuff correctly for the sashes. The size of the window generally refers to the brickwork opening, so that when

setting out the opening is marked first and then the outside lining is set out to the margin required.

Mullion Windows.—Fig. 26 shows the simplest type of mullion window. The chief advantage is that the narrow mullion does not exclude much light. Only the centre sashes are hung, the outside sashes being fixed. The constructional work procedure is similar to that of the sash and frame window, except for the arrangement of the pulleys, an extra pulley being required for each cord. It is necessary that the cord should run over the outside sashes owing to the weights being on the outside of the frame, and this necessitates the pulleys being at the top of the pulley stiles and mullions. Figs. 27 and 28 show the method of arranging the pulleys in the mullion. The mortise does not go any deeper than is necessary for the pulley and a narrow groove is made for the cord to pass through the remainder of the thickness. The ordinary pulleys may be used with the top flange broken off. The head holds the pulley securely at the top, so that the screw at the bottom is sufficient. Instead of breaking off the flange it may go into the head, or, if preferred, special pulleys may be purchased. The top fixed sash is rebated for the cord to pass over, and a wide guard-bead is used to cover the cords. The bead is removed in elevation to show the cord passing over the sash. This guard-bead is screwed so that it is easily removed for rehanging the sashes when required. The mullions are cut square to the same length as the pulley stiles. Triangular blocks are glued to the head and top linings as shown in section to strengthen the linings and also two strengthening blocks (B Fig. 26). Fig. 27 shows the arrangement of the pulleys and cord. If all the sashes have to be hung, the mullions must be framed for the weights, as on the outsides. The objections to this window are the labour it entails and the light it excludes, as the mullions have to be of sufficient width to take the four pulleys. Fig. 29 shows an alternative method, where one weight acts for two sashes, but this is very troublesome for rehanging. The weight is cast with lead and may be square or circular. A special pulley is inserted and a rivet passed through. Fig. 30 is a line diagram to show the proportions.

Yorkshire Light.—This window (Fig. 31) is easy to make and very satisfactory in every sense. The frame consists of two stiles, head and sill, formed of 5 in. by 2½ in., and an upright bar in the centre of 2-in. by 2-in. sash stuff, or 2½ in. by 2 in. specially prepared as in Fig. 32. One half of the frame is rebated for glass, and the other half is arranged for a sliding sash.

Both the sill (which should be of hardwood) and head run through, and the stiles are tenoned into them. Double tenons may be used if desired, but they entail a lot of labour; and one big tenon, say 1½ in. with two large nails to assist it, is quite good enough. The head is shown rebated for the sash to slide in, and the sill is ploughed for an oak or wrought-iron lath to act as a runner. An oak lath may be used at the top also in place of the rebate. In that case the guard-beads only serve to keep out the draught, and may be dispensed with if desired. That would mean a narrower frame. The sash is formed of 2 in. by 2 in., or one stile may be prepared, as shown in Fig. 32. The stiles run through, and the top and bottom rails are tenoned into them in the ordinary way. The bottom rail should be of hardwood, as there is considerable wear between the sill and bottom rail. Very often small pulleys are let into the bottom edge of the rail to ease the friction, the pulleys running on a strip of hoop-iron. Metal shoes are sometimes used running on a strip of wrought iron. If a lath is used at the top instead of the rebate, it is necessary to put the sash and lath in together, and then screw the lath to the head whilst regulating the sash for easy running. Bars may be used according to the size of glass required. The sash is secured by a thumb-screw, which passes through the loose sash and into the fixed upright bar. Fig. 32 is a section through bar of frame and stile of sash showing alternative methods.

Casement Windows.—These windows consist of the frame and one or more sashes, opening on hinges. If the casements or sashes come down to the floor, so that they may be used as doors, they are called French casements. With regard to details and design, no windows are as subject to variation as casement windows, so that these makes are largely a question of individual taste.

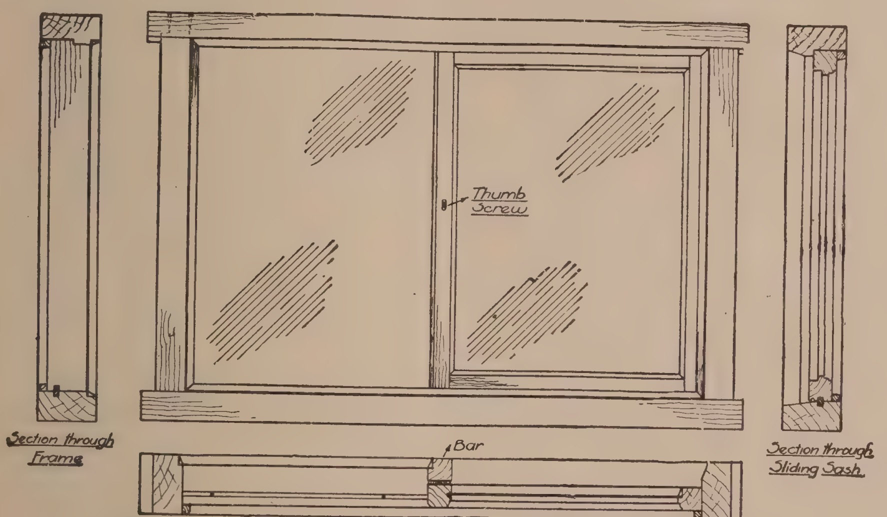


Fig. 31.—Two Sections, Elevation and Plan of Yorkshire Lights

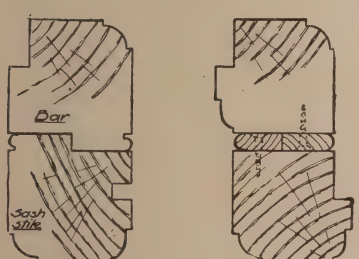


Fig. 32.—Two Constructions of Sliding Bar and Stile of Yorkshire Light

Fig. 33 shows a simple type with a centre mullion. Four casements are shown, but it is not necessary for all of them to open. All the sashes in this window open outwards, and this necessitates the top ones being hinged to the head. Very often the sashes are all made to open inwards, but this generally gives trouble with the bottom rail of the bottom casements, owing to the rain beating in. Patent metal water bars are obtainable for the purpose of keeping out the wet. Sometimes the top sashes are arranged to open inwards and the bottom ones outwards, which is a very satisfactory method. The chief constructional difficulty with casement windows is the preparation of the various sections. especially the transom. It is an easy matter if machines are available, but entails a lot of hard work by hand. It is usual to partly cut for the shoulders and tenons, and do the mortising before the moulding and rebating. If the tenons are finished completely before the rebating and moulding, it is difficult to get a seating for the planes, also the shoulders get bruised. This refers to making by hand. Casement stays are placed on the bottom rail of bottom casements, to prevent them blowing open. and also to fix them into any desired position. Casement fasteners are used to fasten them when closed. The top sashes are hinged to the head and a

quadrant fixed at the transom. Leaded lights are usually put in the top sashes and are very effective. The drawings show clearly all the details. Care must be taken with the various throatings, otherwise the rain will prove a source of trouble. Weep holes (shown by dotted lines) are bored in the top rails of the casements, to allow any water gathered in the throating to escape. Only one is required in the centre of each rail, but the groove should be slightly deeper at the weep hole than at the ends, so that the water will get away.

Fig. 34 is an enlarged detail of the hanging stile showing the method of letting in the hinges, and also the throatings, either or both of which may be used. The inside of the frame should be prepared for the window bottom and the linings or plaster. It is usual to plough grooves for this purpose. The right-hand stile in plan (Fig. 33) shows an alternative method of

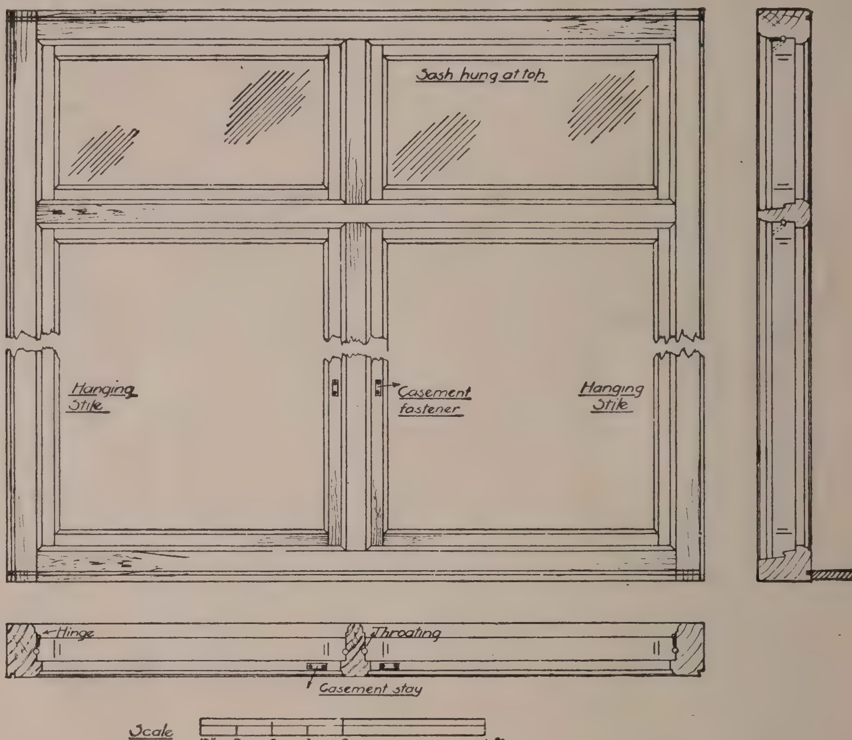


Fig. 33.—Elevation, Section and Plan of Casement Window

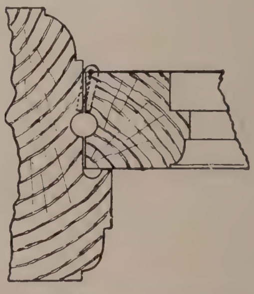


Fig. 35.—Arrangement of Hinging for Window to Open Inwards

Fig. 34.—Detail of Hinging Stile to Casement

forming a key for the plaster. If it is required to open the sashes inwards, the details necessary to make a satisfactory window are shown in Fig. 35. The water is certain to get through at the bottom rail, but the section of the sill will allow it to run out at the weep holes. The weep holes are bored with brace and bit, and then the holes are charred with a red hot iron, or filled in with brass tubing. In these details the top sashes are hung at the transom and opened by a quadrant at the top.

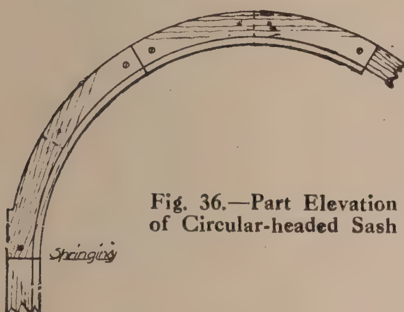


Fig. 36.—Part Elevation of Circular-headed Sash

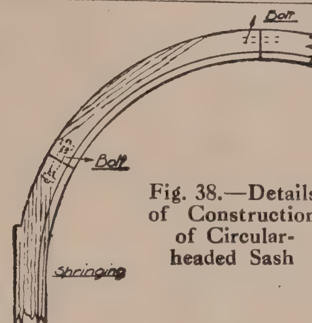


Fig. 38.—Details of Construction of Circular-headed Sash

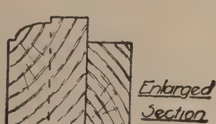


Fig. 37.—Section of Circular-headed Sash

Fig. 40.—Method of Binding Head or Linings

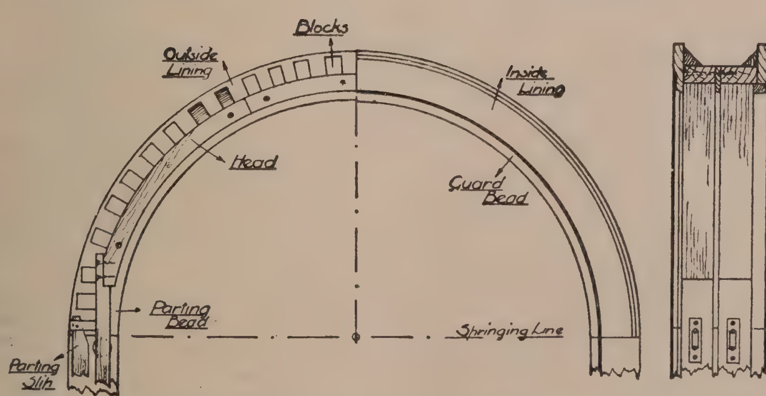


Fig. 39.—Part Sectional and Side Elevation of Circular-headed Sash and Frame

Circular Framing.—When building up circular framing, it is generally better to build up by dividing the thickness into layers and crossing the joints, then gluing and nailing or screwing the several layers together. Fig. 36 shows this method very clearly. The section of the sash stuff is divided into two parts. The division is arranged according to the members. It should be as near to the centre of the stuff as possible, but the first consideration is the ease in sticking the mould. For instance, in Fig. 37 if the section is

divided into two layers it is much better to divide as shown by the full line than by the dotted line, as the latter would entail the sticking of the mould on one piece and the rebate on the other, whereas the full line only requires a narrower ring to form the rebate. The number of the joints depends upon the radius of the circle and the width of the material available. The success of the work depends upon an intelligent division of the joints.

If the framing has to be cut out of the solid, the method of making the joints is by hammer-headed keys or by handrail bolts, sometimes assisted by dowels, as shown in Fig. 38. The latter is perferable for small work. The joints should radiate to the centre for striking the curves. In all circular work it is necessary to set out the work to full size and to cut thin templets for the various members required, so that they can be applied when cutting out the planks or boards. If the radius is not too small it is better to steam and bend any small section that is permanently fixed, such as the guard-bead in Fig. 39, which shows the circular part only of a circular-headed sash and frame. The lower portion is as already described for a sash and frame.

The chief difficulty is the circular head to the pulley stiles. Two methods are available. First by means of layers built up of three layers, the parting bead forming one layer. This method has been described already. The second method is very good and is more favoured by the majority of craftsmen. That is, to bend the head to the required shape. This may be done in two ways. If it is a large radius, the usual way is to cut out as shown in Fig. 40. Then bend to the required shape and fill in the notches with wedge-shaped pieces of pine, the length of which is equal to the width of the head. These pieces are well glued and driven in tightly, and the whole allowed to dry before being disturbed. It is necessary to prepare a temporary drum or saddle to bend the work round. For a semi-circular head or any work with a small radius it is better to commence with a piece sufficiently thin to bend round the drum and then glue blocks on the back, afterwards gluing on canvas. The point where the bending commences is called the springing, and a few inches of material should be left on below the springing to secure to the stiles and to fix to the drum. With the second method the parting bead should be planted on, instead of arranging for a groove. Tongues entail a lot of labour and are not worth the increased cost. Glue and nail on the inside and outside circular linings, and then block well inside the head. In Fig. 36 one half of the inside lining is omitted to show the joint between the stile and the head. The stile runs up and screws are put through from the back. The method of fixing the parting slip is shown. A block is fitted in tightly between the linings, and slotted or mortised for the slip. It is necessary to prepare a stop on the sash and the frame, otherwise the sash would bang on the head at the crown and break the glass. This is shown on the elevation of the sash (Fig. 38), which is drawn separately for clearness. The sash may be prepared in concentric layers, as in Fig. 33, or by cutting the material out of the solid and jointing by means of handrail bolts or hammer-headed keys, as in Fig. 38. Concentric layers construction is easier for hand work.

For a segmental head the preparation would be the same for the frame, except for the joint between pulley stiles and head. In this case it is better to trench the head for the stiles as if it were a straight head. Also on the sash, the joint between head and stile would be an ordinary open mortise-and-tenon joint and pinned. For a very flat segmental arch, as is commonly found in cottage property, it is usual to keep the head to the pulley stiles straight, and follow the curvature of the brickwork with the outside lining only. This necessitates the top rail of the sash being wide, and the under edge cut to the same curvature as the lining.

Bull's-eye Windows.—This term is applied to small circular windows the sash of which opens as a whole on pivots (Fig. 41). The building up of the frame and sash is as previously described for circular work.

Both frame and sash should be divided into two thicknesses. The beads will be cut out of the solid. Prepare a board the same thickness as the width of the bead. Cut out the inside of the bead to the correct sweep, then work the bead by means of a router and cut off with a bow saw, or band saw if available. Part of the bead on each side fixes to the sash and the other part to the frame. The sash will open in at the top so that the bead at the top should be on the inside, and the bead at the sash and beads, to give the required size, and glue them on to the frame.

If a straight surface is left on the frame when preparing, and the corresponding portion cut off the sash and beads when fitting, it is better for outside work as the small pieces glued on are apt to get broken off in time. Fix the pivot to the frame and the eye to the sash, then the groove, necessary to slip the sash into position, can be made in the bead so that it will not show when the sash is closed.

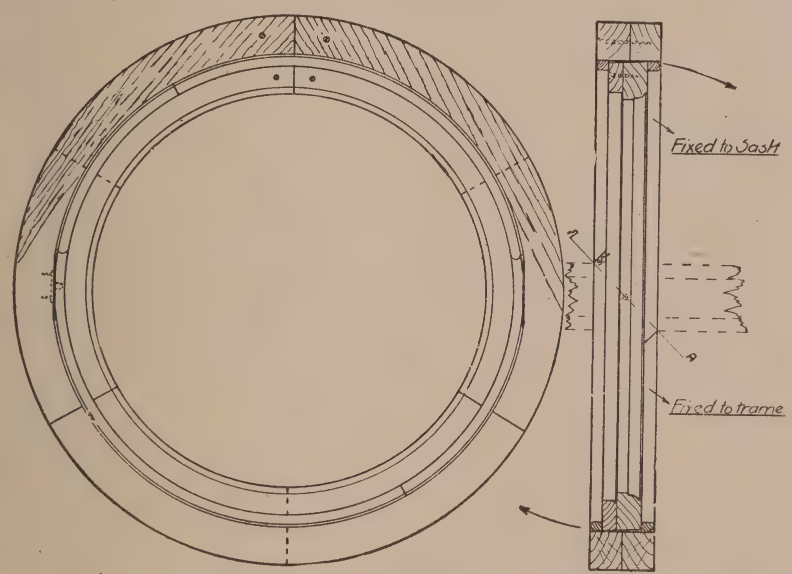


Fig. 41.—Elevation and Section of Bull's-eye Window

the bottom on the outside. The drawing shows the method of cutting the beads. Set out the sash and beads when open horizontally, as shown by dotted lines, then draw the line A A through the intersections of the two drawings. The cut for the beads is at right angles to the line A A, and from the points of intersection. The pivoting is rather a difficult operation. First it is necessary to have a plane surface on the frame at the centre, equal to the thickness of the window. The plane surface will be a square. For good work, the best method is to cut pieces off

Circular Louvre or Ventilator.—Fig. 42 gives the section and elevation of a circular ventilator. The frame should be prepared as in the previous example, either by cutting out of the solid and using handrail bolts or hammer-headed keys, or by building it up in two layers and crossing the joints.

The setting out for the louvres and the cutting of the louvres is an interesting geometrical exercise. The drawing shows the top surface of the top louvre developed, or the true shape to which the louvre is cut. Consider the front edge A A as an axis, and

revolve the louvre about this axis until it is perpendicular.

In the section, this revolving is shown by the edge A 2, 3, 4, 5. It is turned vertically to A 5′. In the elevation the point 5, when revolving, will follow a path at right angles to the axis until it reaches the same height as in the section. So from point 5 draw a vertical line, and the place where a horizontal line from 5′ in the section cuts this vertical line will be the point required. Repeat for points 2, 3, and 4, and draw a curve through these points. This gives the true shape of the louvre.

By this method it is necessary to repeat for each louvre, which is very tedious, the practical method described below being much simpler. For this method set out two rods or boards, with the edges of the louvres marked on the edges of the rods. These rods will be exactly alike. Put the frame together temporarily, fix the rods one on each side, and with a straightedge mark the positions of the louvres both on the face and the back of the frame. The rods B B, and the method of applying them, are shown in Fig. 42. Next, take a piece of cardboard, equal in width to the thickness of the louvres, set it to the marks on the front and back of the frame. Mark on each side of the cardboard, and this gives the cuts for the louvres. Take the frame asunder and cut out to the marks to a depth of half an inch. Now put the frame together permanently. To cut the louvres, set out a quarter ellipse as shown in Fig. 43.

To obtain the axes, set out a line equal to R in Fig. 43. Draw a right-angled triangle with the hypotenuse at 45°, because the louvres are inclined at 45°. The hypotenuse is the major axis, and the base R is the minor axis. Draw the ellipse. Apply this templet in the grooves for the louvres until a portion is found to fit. Mark this portion and apply it to the louvre. Get the edge cut by means of a bevel for both front and back.

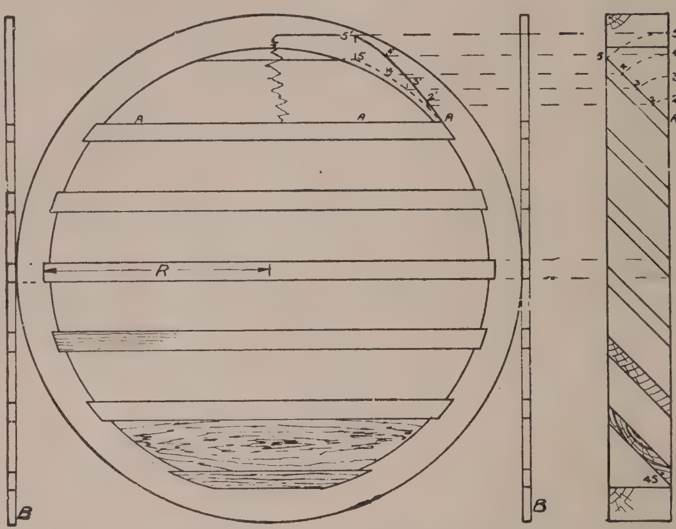


Fig. 42.—Elevation and Cross Section of Circular Louvre showing Method of Setting-out

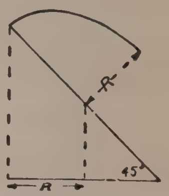


Fig. 43.—Method of Setting-out Louvres

Fixing Woodwork to Walls

THE fixing of woodwork depends largely upon circumstances, the position of the work, what strain it will have to stand, and the kind of wall, etc., to which it is fixed.

The usual method is to plug the walls, but there are other methods equally good such as holdfasts and plate dowels (Fig. 1), building-in slips, wood bricks, breeze blocks, etc., during the course of erection.

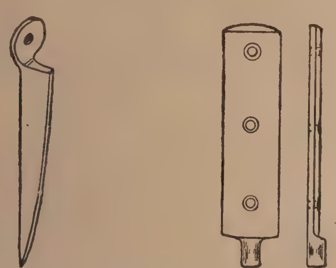


Fig. 1.—Holdfast and Plate Dowel

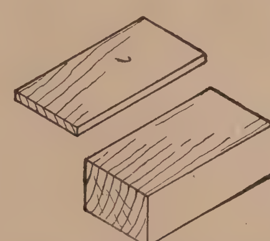


Fig. 3.—Pallet and Nog for Brickwork

In America, Swedish putty is often used and the results are very satisfactory. The woodwork is smeared round the edges with the putty where it comes in contact with the wall. The fixture is then pressed into its position and two or three light rails driven in, or any other method used that will hold the fixture in position until the putty is set. The surplus putty,

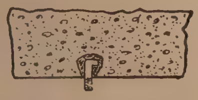
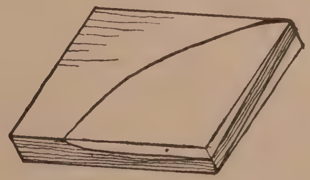


Fig. 2.—Holdfast for Concrete shown Fixed

Fig. 4.—Plug and Method of Cutting



which has been pressed out, is cleaned off as soon as possible, as it sets quickly. Many workmen assert that this is an excellent method. It is certainly clean, labour saving, requires little skill, and is efficient.

A good method in concrete is to cut out the concrete to the required size, and

The nog is exactly the size of a brick. The latter is not always satisfactory owing to shrinkage, but the slip is excellent if the required positions are known. Plugging is generally adopted, because the plugs can be placed just where they are required, but this method entails more labour and often disturbs the brickwork.

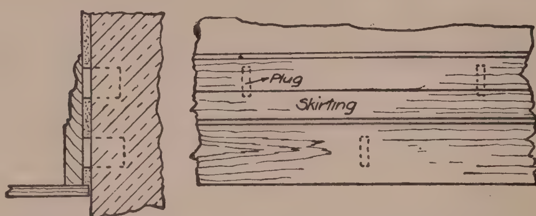


Fig. 6.—Section and Elevation of Skirting Board, etc., showing Method of Fixing

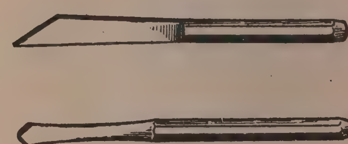


Fig. 5.—Plugging Chisels

wider at the back of the hole. Fill in with quick-setting cement or plaster-of-paris, and quickly insert any fastening required (Fig. 2). If an ordinary screw is used, grease before insertion for easy removal. This method is used because wood plugs are of very little use in concrete walls or ceilings.

It is usually against the local bye-laws to put timber in chimney flues, so that metal fastenings are used, such as holdfasts and wire hooks instead of plugging.

After the completion of a building, if it is desirable that the walls should not be damaged, plugs and metal fixings are nearly always adopted.

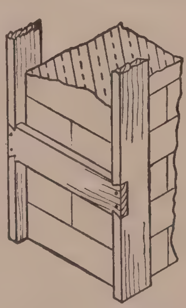


Fig. 8.—Method of Fixing Door Casing

Fig. 7.—Method of Fixing Angle Boards

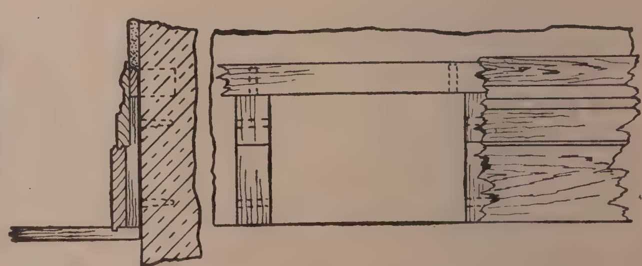


Fig. 9.—Section and Elevation of Built-up Skirting, etc., showing Method of Fixing.

Fig. 3 shows the wood slip or pallet and nog which are built in as the building proceeds. The slip is the size of a brick (9 in. long by $4\frac{1}{2}$ in. wide), with the thickness equal to the joints in the brickwork.

There are various methods of plugging. By raking out the mortar from the joints of the brickwork and driving in a plug made as shown in Fig. 4 (*see* page 72 for photograph of the operation).

If the joints are difficult to find, or the wall is built of masonry blocks, drilling a circular hole with some form of steel drill and driving in a square or circular plug is a better method.

There are several patents on the market, similar to the latter method but with some form of improvement. One of them is to insert lead plugs, which are split at one end. The plug is hollow, similar to small lead piping, and as the screw is screwed into position, the split end opens and grips tightly in the hole. These plugs are very good in hot rooms where timber would shrink.

Fig. 4 shows the method of cutting the plug, also a section through the centre. It will be noticed that the end driven into the wall is nearly parallel like the joint which it has to fill. Also it is slightly twisted by chopping more off one edge than the other, similarly on both sides.

Sawn plugs are often used if a large quantity is required, but they are never so satisfactory; they are wedges rather than plugs, and so can only grip at the outer edge of the joint, whereas it is more important to grip at the back of the joint.

Fig. 5 shows two common types of plugging chisels. Plugs should be split from straight grained yellow pine, and tapered by means of the axe. The square or circular plugs are prepared with the chisel.

Plugging in New Work.—The distance apart of the plugs depends on what has to be fixed to them, and the strain to which the work will be subjected. They are usually driven in the horizontal joints for vertical fixtures, and in the vertical joints for horizontal fixtures.

For narrow skirting, picture rails, dado moulds, etc., the plugs should be about every three bricks apart. Rake out the mortar to a depth of $2\frac{1}{2}$ in., drive in the plug firmly, and cut off $\frac{3}{4}$ in. away from the brickwork to allow for the thickness of the plaster. Wide skirtings and built-up skirtings require two rows of plugs and they should be in triangular form, as shown in Fig. 6 in section and elevation.

When fixing door casings the opening is plugged up the sides. Three plugs are sufficient on each side for a 6-ft. 8-in. frame, but if there is no fixing to the floor and lintel, then four plugs are necessary.

The external angles of brickwork when plastered are generally provided with "angle beads" running from floor to ceiling. The plugs are driven in the joints, as shown in Fig. 7, about every 2 ft. in height. They are cut off, so that the bead finishes flush with the plaster on both faces of wall.

Fixing High-class Work.—In better-class work "grounds" are fixed to the plugs and the finished work is fixed to the grounds, sometimes by means of slotted screws. If the fixtures are polished hardwood this latter method is only used in first-class work and would prove very difficult for the amateur.

If grounds are being fixed, the same procedure is necessary for the plugging, but the plugs are cut off level with the brickwork, and the grounds finish level with the plaster. Fig. 8 shows how to prepare the grounds for a door casing. The angle at the top of the door opening should be halved.

Fig. 9 shows section and elevation of grounds for a built-up skirting, consisting of a horizontal ground and short vertical grounds about 2 ft. 6 in. apart. The groove on the floor board for the skirting is seldom done owing to the amount of labour it entails.

In all this work it is necessary to be straight, plumb, and generally level. The chalk line is useful to ensure a straight length. This is a length of twine well chalked and pulled taut across the plugs. It is fastened at each end to the correct position, then raised in the centre and released suddenly (*see* photograph on page 32). Or the plugs may be marked separately, direct from the line, by means of a foot square placed with a stock on the floor, and a pencil; this at once gives a plumb line and the position for cutting.

The plumb bob and rule are used for vertical surfaces (*see* Fig. 10 for method of using the rule). The bob, which is of lead or brass, swings freely, and the work is regulated until the string covers the centre line of the rule.

For plumbing small work, the level resting on the stock of a foot square is all that is required, the blade being used in the same way as the plumb rule.

Fixing to Plastered Walls.—Fixing in finished buildings necessitates slightly different methods. It is desirable that the walls should not be damaged, hence it is difficult to find the brick joints. The drill is therefore used more than the plugging chisel. There are many forms (*see* Fig. 5), but they are all used in the same way. Give the drill a circular motion in the hand whilst striking with the hammer. When the square or circular plug is driven in, cut off level with the plaster, then give another hit with the hammer. The plug should be just under the surface of the plaster, so that the fixture will pull tightly on to the plaster when being fixed.

Fig. 10.—Method of Using Plumb-bob and Rule

Fig. 11.—Method of Fixing to Girders

Fig. 12.—Rawlplugs, Without and With Screws Inserted

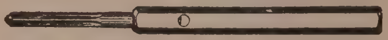


Fig. 13.—Rawlplug Drill and Holder

Various Fixing Devices.—Fig. 11 shows a method adopted by electricians, etc., in mills and warehouses. The pieces of bent metal, about 1 in. by $\frac{1}{4}$ in., hang on to the flange of the girders. They are tapped to receive a set-screw, which passes through anything it is required to fix on to them.

The holdfast is very convenient for fixing windows, door frames, or any kind of frame in brickwork openings (reveals). It is a rough method of fixing but very efficient. The holdfast is driven into the brickwork joint, and a screw put into the fixture (*see* Fig. 1).

Dowels are cylindrical pieces of iron, about 3 in. by $\frac{1}{2}$ in., used in the feet of posts, etc., which have to sit on stone or concrete. The application is shown in the section on doors and frames.

Plate dowels serve the same purpose as the dowels, but they are used after completion, and where the first fixings have failed. They are the especial friend of the property repairer. The stone or concrete is drilled to receive the dowel and the plate is screwed on to the face of the woodwork (*see* Fig. 11).

The Rawlplug outfit is useful and cheap, whether for the use of the skilled craftsman or of the amateur. The plug consists of a tube of stiffened fibres which expand when the screw is driven into them, thus making a secure fixing (*see* Fig. 12).

The drilling tool consists of the drill and the holder (Fig. 13). The drills and plugs are in various sizes. Probably the most suitable size for average work is number 12 or 10, with plugs of assorted lengths. No skill is required, and when completed gives a strong and very neat fixing. It is extremely useful for marble, glazed tiles and other materials that require great care when driving in ordinary plugs owing to the brittle nature of the material.

Methods of Fixing after Plugging.—Any fittings or fixtures standing on the floor must be fitted to the irregularities of the floor. Very often the fixture is not fitted, but only the plinth which is fitted on afterwards.

The following description of scribing a skirting to the floor is typical of other fittings.

Cut the skirting to length, then tack temporarily to two of the plugs, aiming to get as level as possible, and also considering the skirtings on the adjacent walls. Thickness a small piece of wood to the greatest irregularity. Then, with a pencil lying flat on the piece of wood, run it along the floor, marking the skirting along its whole length. Scribing compasses are better for the purpose if they are at hand. Cut to the pencil mark by means of axe or saw.

The internal angles or corners of the skirting are scribed, because the skirting is apt to drive in further than expected when nailing on to the plugs. In any case scribing gives a more satisfactory internal angle. The external angles are mitred.

If the floor is very irregular it is wise to cut the skirting for all round the room, and test for any exceptional hollows in the floor, then some idea can be formed as to the amount to be scribed and cut off.

Picture Rails, Shelving, etc.—Above the picture rail is generally an ornamental frieze which differs in depth considerably according to taste. If the frieze is paper it is necessary to ascertain the depth from the decorator.

Cut two strips of wood equal in length to the depth of the frieze, and use these as distance pieces whilst nailing the mould on to the plugs. If the ceiling is not straight, the mould must be kept straight, and the greatest distance between ceiling and mould should be equal to the depth of the frieze. The chalk line is used to get the straight line on the wall.

The corners are treated in the same way as for the skirting.

As a temporary or movable rail, circular rods about 1 in. in diameter, and enamelled white, are very effective. These simply rest on brass fittings plugged and screwed to the wall about every 4 ft. apart.

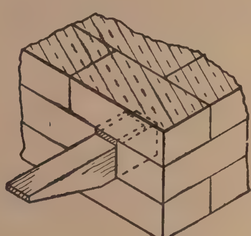


Fig. 14.—Old Method of Fixing Shelves

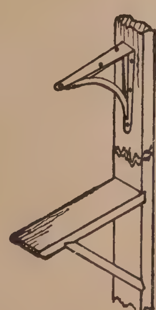


Fig. 15.—Fixing Shelves by means of Cleats and Brackets

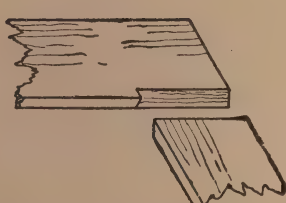


Fig. 16.—Preparation of Shelves to be Fixed at Right Angles

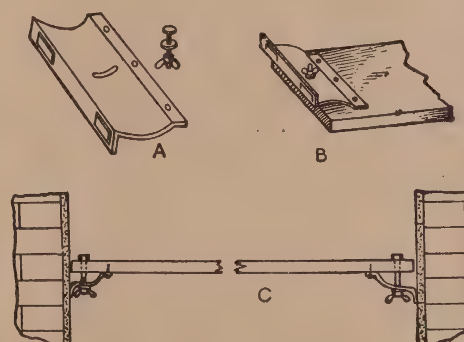


Fig. 17.—Adjustable Shelf Support and Method of Using

Shelving.—The old-fashioned method of fixing shelves was to cut out a portion of a brick and wedge in the wall a 3-in. by 2-in. shelf nog (Fig. 14) about every 4 ft. apart. A much better method, especially if there are more than one row of shelves, is to plug and fix cleats on to the wall; then screw cast-iron or steel brackets on to the cleats (Fig. 15). The brackets may be formed of timber, if desired, as shown.

Where the end of a shelf butts up to a wall, horizontal cleats are fixed on the wall to carry the end of the shelf. The cleat should be about 2 in. by 1 in., and chamfered. When one shelf is fixed at right angles to another shelf they are prepared as shown in Fig. 16. If this is too much trouble a strip of wood may be screwed on the underside of the shelf running through to the wall for the end of the second shelf to rest upon.

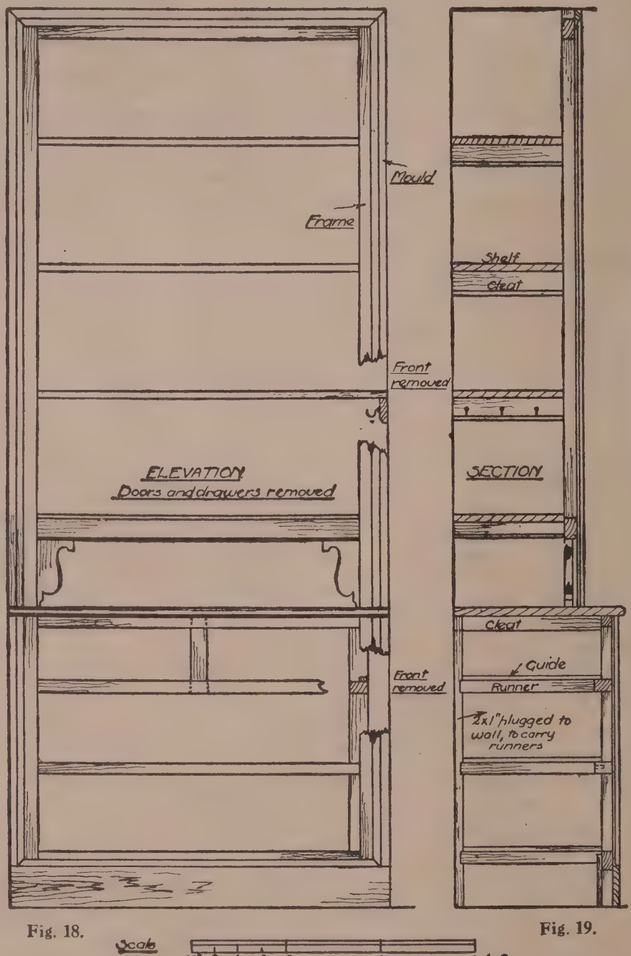


Fig. 18. Fig. 19.

Figs. 18 and 19.—Elevation and Section of Cupboard and Shelves for Recess

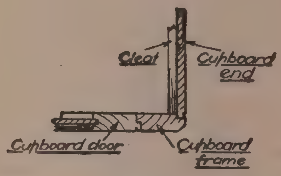


Fig. 20.—Method of Using Cleats for Fixing Shelves

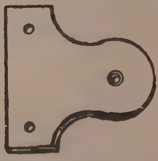


Fig. 21.—Glass Plate

Many forms of adjustable shelves are now on the market, and the advantages are obvious, as they can be regulated to any height required.

Fig. 17 shows the Ford patent shelf support. This is a very good device to prevent any damage to the walls. The shelf is cut $\frac{1}{8}$ in. shorter than the distance between the walls. Then the attachments are screwed on each end, and the thumb-screw which passes through both shelf and bracket is tightened up. This presses the attachments into the wall. It is claimed by the inventor that the greater the weight the greater the security. In Fig. 17 A shows the support, B the support screwed on a shelf, and C when the shelf is fixed in position.

Cupboard with Shelves.—First fix horizontal cleats, level, and to the required heights. They should be about 3 in. deep, then cup hooks may be screwed into them (*see* Figs. 18 and 19). The shelves are nailed to the cleats.

For cottage property in course of erection the shelves are fixed before the plastering is done. Two plugs at each end are considered sufficient for the shelves to rest upon, and the plaster does the rest. Often nails take the place of the plugs in "jerry" building.

The front edges of the shelves are kept plumb, and the cupboard frame is nailed to the shelves, the bottom shelf forming a rebate for the doors. An architrave or lining, fixed round the frame to break the joint between frame and plaster, completes the fixing. This description applies to a cupboard between two walls. Where there is only one wall it is necessary to have an end to the cupboard. This carries the shelves by screwing on cleats (Fig. 20). The end and shelves must be securely fixed to the wall and, if possible, the end should be run through the plaster ceiling and nailed to the ceiling joist unless it runs to the floor, and a bottom cupboard formed. If the end does not go to the floor, cleats should be fixed along the wall to carry the back of the shelf.

If there are drawers to the lower portion, then the cupboard and the drawers are two separate pieces of framing; Figs. 18 and 19 give details of a fixture of this description for a recess, with drawers omitted. To the housewife this is one of the most useful pieces of furniture about the house, and should be included in every cottage.

In the case of overmantels, mirrors, hanging bookcases, etc., which are fixed flat on to the wall, small brass plates, known as glass plates, are used (Fig. 21). These are screwed on to the back of the fixture, the fixture is placed in position on the wall, and the screw holes marked on the wall. The exact position is drilled, and a small plug driven in. Leave as little of the plate showing as possible.

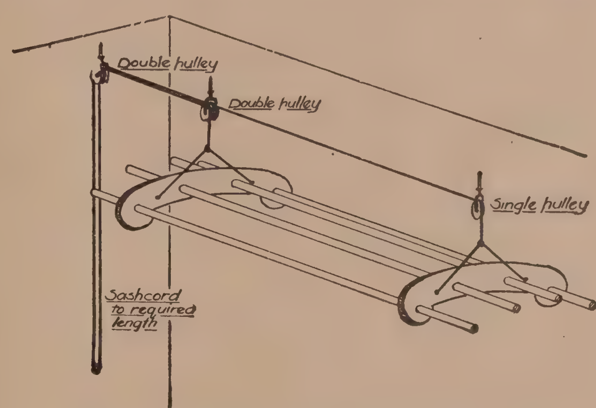


Fig. 22.—Method of Suspending Clothes Rail

If it is desired to have the fittings movable, the plates may be purchased with slotted holes.

Clothes Rails.—In some parts of the country these are considered necessary for drying and airing the clothes. The method of fixing is very simple. The pulleys are screwed into the joists and the cords fix on to the rail, run over the

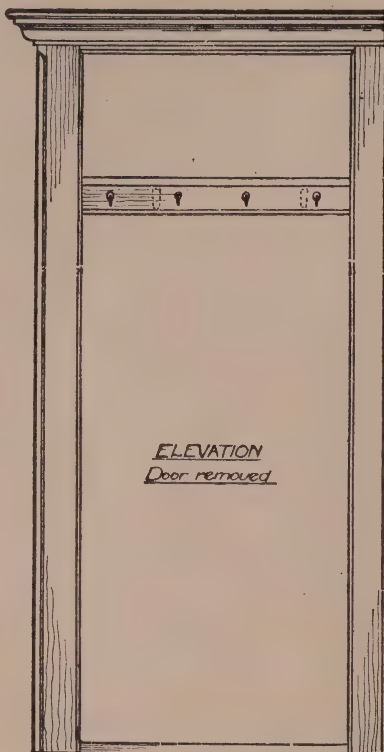


Fig. 23.

Fig. 24.

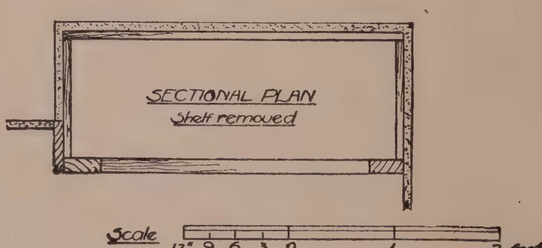


Fig. 25.

Figs. 23, 24 and 25.—Elevation, Vertical Section and Plan of Wardrobe for Recess, showing Method of Fixing

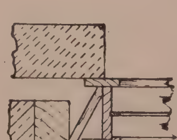


Fig. 26.

Figs. 26 and 27.—Method of Fixing Window Frames

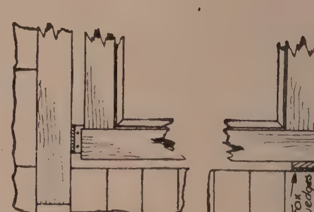


Fig. 27.

system of pulleys and down the wall, where the cord can be manipulated to raise or lower the rail.

Difficulty in locating the joists is sometimes experienced. If the ceiling has not been decorated for some time, the lines of the joists are easily seen. If not, go into the room above and look for the nails in the floorboards. This will give the direction of the joists, then select the joists you require, measure the distance from the wall, and mark the same distance on the ceiling below. By gentle tapping with the hammer on the ceiling the joist is easily found. Then bore with brace and bit into the joists, and screw up the pulleys. Fig. 22 shows the rail in position with the pulleys taken out of the ceiling.

Wardrobe.—This is a very simple piece of furniture for the amateur to construct. The method of procedure is similar to the cupboard. The cleats into which hooks may be screwed should be 3 in. wide, and run round the ends and back. There is generally only the one shelf, and the top. As the recess is usually not as deep as the wardrobe, a wood lining is added to make out the width. Figs. 23, 24 and 25 show the usual type for cottages. The cleats are first plugged to the walls, then the shelf is fixed and then the frame, which consists of stiles and head only. The top is placed on afterwards, and any moulding required for ornamentation. A strip of wood is nailed on the floor in the door opening. This prevents any trouble with the door and the carpets, and also prevents the dirt being swept into the wardrobe. The door frame may be prepared for an ordinary 6-ft. 6-in. by 2-ft. 6-in. panelled door. Screw revolving wardrobe hooks may be fixed on the underside of the shelf.

Windows.—Only two types of windows are dealt with as coming within the scope of this section. First, the fast sheet (*see* section on windows); this may be fixed by wood slips, plugs, or holdfasts. The latter are very good for this purpose if covered by linings. The frames must be bedded on the bricks with mortar, with a little cement or hair added. This sill is generally bedded in thick white-lead and boiled oil. Plugs are driven in at the top and bottom to get equal margin outside.

The sash and frame requires different treatment. Secondly, there may be a wood lintel above the opening and short pieces of wood about 3 in. or 4 in. by 1 in. are pressed against the outside linings, one at each side of the frame. The other end of the 3-in. by 1-in. piece is nailed to the lintel. The sill is fixed by driving in fox wedges between the end of the sill and the brickwork. This fixing at top and bottom is quite sufficient, unless the frame is an unusual height, when holdfasts should be driven in the brickwork up the sides. Figs. 26 and 27 show the method of fixing.

In many of the concrete block systems breeze blocks are used on the inside, and as these give secure holding to nails, etc., much of the laborious preparation is done away with, to the great satisfaction of the workman, and especially so to the amateur.

This section has only dealt with the general principles of fixing and their application to a few typical woodwork examples. Numerous other examples of shelves, cupboards, etc., are given in other sections.

Bevelled Work and Curved Work

THERE is no difficulty in setting out bevels for work that is splayed in only one direction. Consider, for example, the box shown in Fig. 1. The long sides are inclined but the ends are upright. The box is also shown in front view in Fig. 2 and end view in Fig. 3.

To make the box the two sides are shaped to the exact section as shown in the end view (Fig. 3), the edges being splayed and tested with a bevel; the length of the sides is given in the front view. The end pieces have to be cut to fit between the splayed sides, and the correct shape of the ends is obtained direct from Fig. 3. It should be noted that the ends of these end pieces are only splayed in one direction, that is, the side of an end must be tested for accuracy with a bevel, but the edge is square and must be tested with a try-square. All the bevels required to make this example are obtained straight from the front and end views of the box.

OBLIQUE WORK

If all four sides of the box were sloping (*see* Fig. 4) the bevels for the sides cannot be obtained direct from the drawings, but must be specially obtained. Work of this kind is called oblique work; the sides of barrows, knife boxes, troughs, wash-tubs and hoppers are usually of this type.

Fig. 4 shows a simple example of a double splayed box (without bottom) having butt joints and level edges. The plan, front, and end views are shown in Figs. 5, 6, and 7 respectively. In this

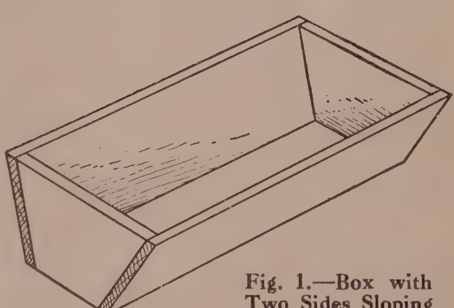


Fig. 1.—Box with Two Sides Sloping

Fig. 2.

Fig. 3.

Figs. 2 and 3.—Side and End Elevations of Box with Two Sides Sloping

example the sides all slope at the same angle and the pieces are all of equal thickness. The sides and ends can therefore be cut from the same piece—which should be made to the section as given in the end view, and the edges tested with a bevel.

The *true* shapes of the ends or sides are not given in the drawings. Consider the inner surface an end; the top and bottom edges, being level, are seen at their true length in plan, but the sloping edges are not seen at their true length; and, what is more important, the width of the surface looks smaller in plan than it actually is.

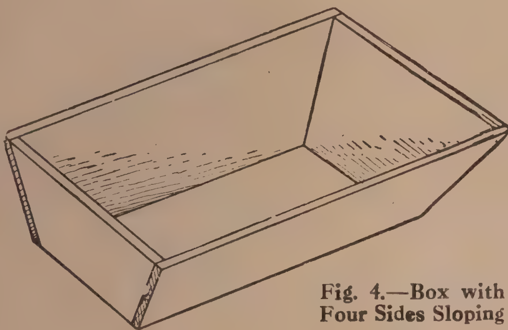


Fig. 4.—Box with Four Sides Sloping

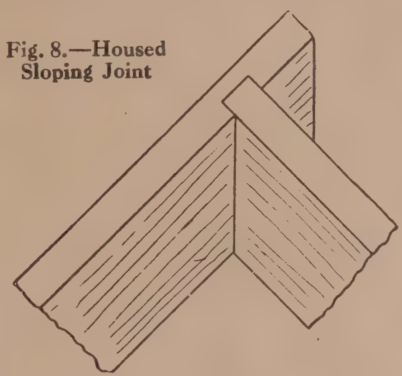


Fig. 8.—Housed Sloping Joint

To get the true shape of the end surface A, imagine the bottom edge to be a hinge and the surface rotated about the hinge until it lies level or flat. When it is level its true shape will be seen in plan. This is accomplished in the drawing by describing an arc with *b* as centre and *b c* as radius, thus giving point B, and then projecting downwards to meet lines from the top corners of the surface. Note that this operation is very similar to closing a trap-door in a floor, when, obviously, points on the door would describe imaginary lines in plan at right angles to the hinged side, and circular arcs in elevation.

Fig. 6.

Fig. 7.

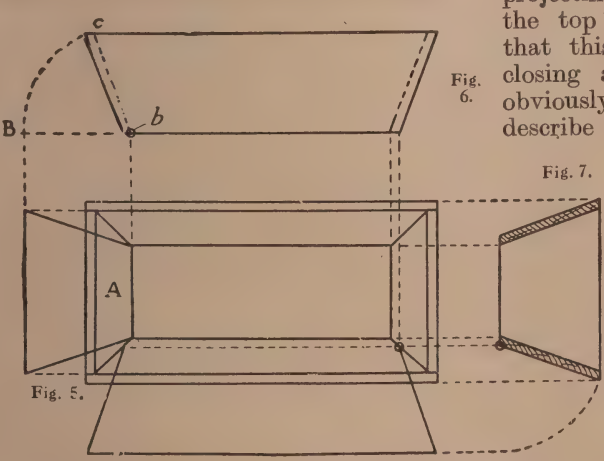


Fig. 5.

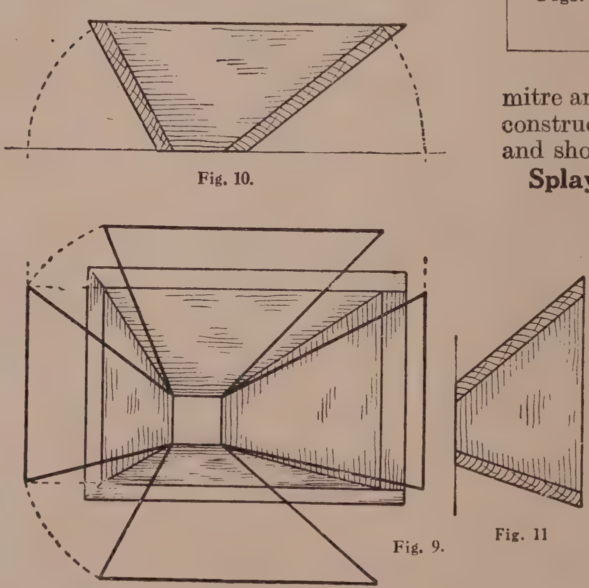
Figs. 5, 6 and 7.—Plan, and Side and End Elevations of Box with Four Sides Sloping

The shape of the ends being obtained the bevel can be transferred to the surface of the piece of wood. The "cut" on the edges is marked with a try-square, and the pieces are then sawn. As the sides and ends slope at the same angle the bevel for the sides is the same as for the ends. To make the example geometrically complete the true shape of the outer surface of a side is shown, the method of hinging or "developing" being the same as for the end. If the joints were housed,

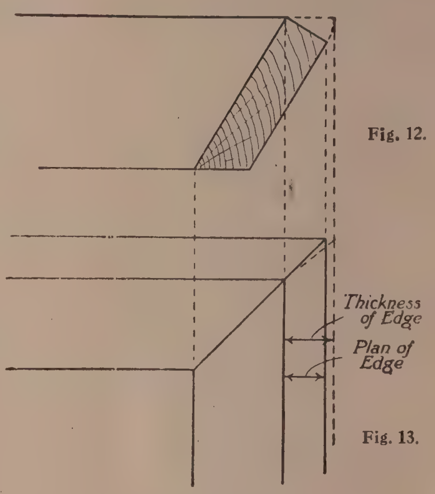
as in Fig. 8, the bevels would not be altered and the edge "bevel" would still be square.

Irregular Splayed Box.—Figs. 9, 10 and 11 show the plan and two sections of a splayed box or hopper. The sides are of equal thickness. The sections should be drawn first and the plan projected from them, in order to get the width of the edges in plan. The edges are level, and therefore the bevels for cutting the mitres can be obtained directly from the plan. Two of the joints are shown butted, in which case the edge cuts are square. The bevels for the sides are obtained by rotating the sides about their bottom edges as before. Note that the four inner surfaces are developed and also that the adjacent edges that join together must be the same length.

Edge Bevels.—If the edges of the box are not level they have to be developed like the sides. Figs. 12 and 13 show the corner of a square-edged box with mitred joints, the thickness of edge being exaggerated for clearness. The edge is hinged about its top corner until it becomes level, and the true width of the edge and the edge bevel for cutting the mitre are shown in plan. The geometrical construction is as for developing the sides and shown in Figs. 12 and 13.



Figs. 9, 10 and 11.—Plan, and Side and End Elevation of Irregular-splayed Box



Figs. 12 and 13.—Method of Developing Edges of Box

Splayed Linings.—Fig. 14 shows the elevation and vertical section of the splayed linings for a window or door. The left-hand half shows the elevation of the edges of the linings.

In order to obtain the bevels for the joints the inside surfaces of the linings must be developed. The top lining is hinged back about its lower edge until its true shape is seen in elevation. The right-hand lining has been dealt with in a similar manner. The geometrical construction is similar to the last example, and should be obvious from the drawing.

Inclined Tube.—Fig. 15 shows an inclined tube, horizontal sections of which are rectangles. The method of develop-

ment should be obvious from previous examples.

Louvre Boards.—Figs. 16 and 17 show the elevation and vertical section of a circular louvre frame. In order to cut the louvre boards to shape their surfaces have to be developed. One board only is shown for clearness.

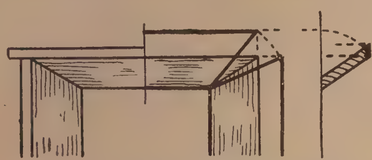


Fig. 14.—Method of Developing Splayed Window Linings

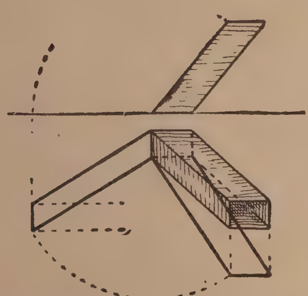


Fig. 15.—Method of Developing Inclined Tube

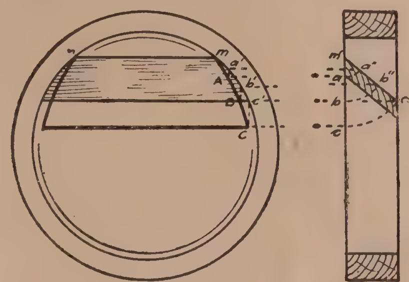


Fig. 16. Fig. 17.

Figs. 16 and 17.—Method of Developing Louvre Boards

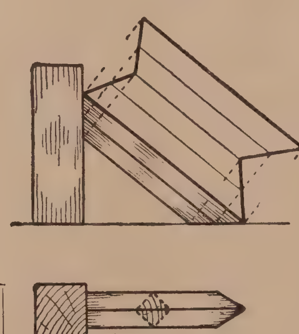


Fig. 18.—Method of Developing Square Inclined Strut

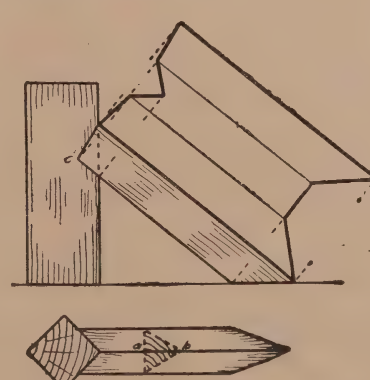


Fig. 19.—Method of Developing Triangular Inclined Strut

The board is hinged along the top edge, and turned backwards and downwards until its true shape is shown in elevation. Choose two or three points on the elevations of the joints as a', b', and c'. Obtain, by projecting horizontally, the side elevations a'', b'', and c''. With m' as centre describe arcs as shown giving points a, b, and c. Project horizontally from these points to meet vertical lines from a', b', and c' in A, B, and C. Draw a freehand curve through m A B C and the shape for the end of the louvre is obtained. This curve is part of an ellipse, because it is part of an inclined section of a cylinder.

Inclined Struts.—Fig. 18 shows an inclined square strut abutting against a post. Imagine the strut to be covered with paper which is joined along the top edge of the strut. Consider an edge of the paper to be held in position along the top edge of the strut and the paper unwrapped from the strut. Draw dotted "path"

lines as shown in elevation intersecting the edges of the strut in the development—note that the distance of the edges apart is obtained from the small dotted section in plan and is equal to the width of the sides of the strut.

Fig. 19 shows an inclined strut fitting against a square post fixed cornerwise. The strut is an equilateral triangle in section, as shown in the plan. Note that the elevation of the strut is equal to *a b* (plan). The point *c′* on the elevation of the joint is obtained by projecting up from *c* in plan. The development is obtained as before, and should present no difficulty.

It will be a great advantage in each of the examples given to cut out the developments in paper and fold into shape. By this means the reason for the geometrical methods used will be easily understood and better remembered.

CURVES

After the constructional side of a piece of woodwork has been designed and considered, the ornamental or decorative features receive attention. First the useful, then the artistic. In this section utilitarian and artistic curved work will be dealt with as far as is generally practical. The simplest case that can be taken is the ring of wood, as in a circular

Fig. 20.—Method of Constructing Circular Ring of Wood

louvred ventilator, the rail of a circular table, or as in the rim of a cart-wheel. These three being articles, serving various purposes, are differently constructed; the rings are built up, and their parts joined together in different ways. The first has been dealt with in the section on windows.

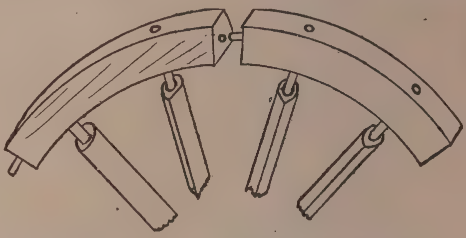


Fig. 21.—Details of Wheel Construction

The rail or rim of a circular table built up of a series of pieces is shown by Fig. 20. The series of layers, when finished, are veneered on the outside. Take, for example, a rim 3 ft. in diameter, 4 in. wide, and $\frac{7}{8}$ in. thick. It would be formed with a series of layers five or six in number, each being $\frac{5}{8}$ in. or $\frac{3}{4}$ in. thick, each layer to form a ring of five or six pieces. The joints of the pieces must not coincide in the layer above or below. Proceed to make a pattern to the shape and length required, and then mark out on a $\frac{3}{4}$-in. board. Cut out with a bow saw, and finish with a spokeshave. The gluing up should be done on boarding on which are drawn the rings showing the plan of the rim. The boarding must be conveniently small enough to allow the pieces to be cramped. Pieces forming the first ring are cut and fitted on the plan, the ends being cut to the pattern, the bevel of which has been obtained by the method previously explained. It is not essential in this case that all the pieces should be of the same length, providing they are approximately the same length and are cut to fit the plan.

There are two methods of gluing the first ring. One is by chalking the board thoroughly all round, so that the glued joint will more readily separate when the rim is finished. The other is by gluing paper on to the board, on which the plan must be drawn, and then gluing the work

to the paper. When the glue is dry, true the surface with a plane, and fit the pieces on for the next ring in the same way. Then glue again, cramp the pieces down all round, using one or two brads or pins for the ends if necessary. When dry, level off and repeat the process until the right depth is obtained. The rim is then released from the board when finished, the inside is cleaned up with a compass plane and spokeshave, and the outside also rounded to a good surface ready for veneering.

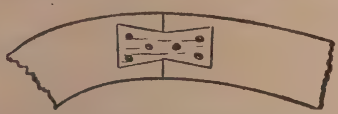


Fig. 22.—Method of Joining Frames, etc.

Fig. 23.—Showing Natural Direction in which Boards Bend

The rim of a cart-wheel is divided up into pieces known as felloes, each being long enough to receive two spokes. They are prepared from a pattern which is a part of a circle larger than the wheel, so as to make the rim higher at the joints. The joints are not fitted close, as in the other cases, but are made slightly **V**-shaped. These are two important matters to allow for the cramping up by the contraction of the tyre. The felloes, after being shaped to pattern, are placed round the shoulders of the spokes of the wheel and the holes marked to receive same. The felloes are joined to one another by means of dowels. After the felloes are shaped and chamfered they are driven on the spokes simultaneously. Fig. 21 is an illustration of same. Some kinds of carriage wheels have the rims in two semicircular pieces, but these are bent by steam at special steambending works. Ash or hickory is generally used for this purpose.

A ring of wood often takes the shape of an ellipse, as in frames for looking-glasses, etc. This requires two or three patterns of different shapes. The method of fixing the joints is shown by Fig. 22. A piece of hardwood, $\frac{1}{4}$ in. or $\frac{3}{8}$ in. thick, of double dovetail shape, is recessed in at the back of the joint, glued and screwed in. After the joints have been cleaned off the mouldings are worked on by means of routers.

The shaping of wood to cylindrical form, as in desk-tops, piano fronts, carriage panels, curved footboards, etc., is done in various ways. Boards can be bent by steam to this shape, and are used where they can be permanently secured by other framework or by iron fastenings. This method of bending is largely adopted in the carriage-building trades, where glued joints, as would be used by other constructions of curved boards, would soften and jar apart in the exposure to the weather and the vibration of the vehicle.

Another method often adopted by carriage and wagon builders in bending a board, when only a slight curvature is required, is by heating the concave side and continually wetting the other side of the board. This can be done by moving the board to and fro over a fire or forge. Advantage should be taken of bending

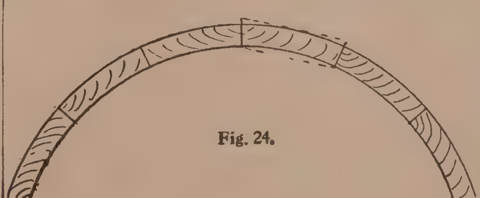


Fig. 24.

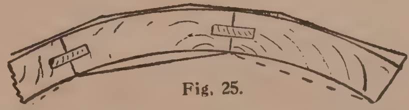


Fig. 25.

Figs. 24 and 25.—Two Methods of Constructing Curved Tops or Covers, etc.

the board in the direction of its natural tendency, that is, the convex or outer side should be nearest the centre of the tree. This can be ascertained by the annual rings. Fig. 23 shows how a board warps or bends naturally away from the centre of the tree unless otherwise prevented. An end view of the board is given, and the annual rings indicate the side nearest the centre of the tree. If the planing is done before the bending, a good finished surface can be obtained with scraper and glasspaper.

The course adopted for making circular desk-tops and such like articles, which are generally veneered as required, should be as follows. First draw the end view of the boards full-size, as in Fig. 24, showing the width of the pieces of which it is made. Supposing the boarding is to finish $\frac{3}{4}$ in. thick, the width should be about 3 in. If the curve is of smaller radius the pieces should be narrower. Hardwood should be used, mahogany being especially adaptable for such work. The thickness of the board can be ascertained by drawing a line from the corners inside, and another line parallel to it and tangential to the outer curve, as shown by the dotted lines. If the curve is circular, the angle for the edges will be equal, and should be taken by the bevel from the drawing. Care is required in shooting the edges to the correct angles, and after testing with the bevel they should be tested on the drawing to make sure of obtaining the correct shape. The joints are rubbed when gluing, which should be done in two or three operations, giving the joint time to harden before being weighted by the extra piece.

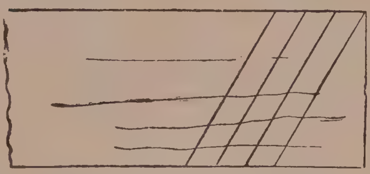


Fig. 26.—Method of Cutting Feathers

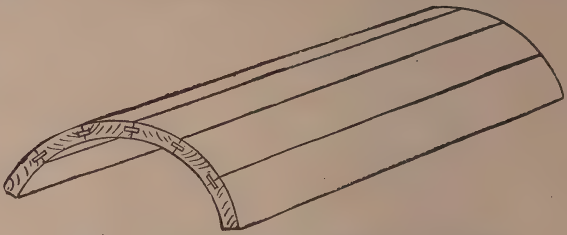


Fig. 27.—Finished Cover ready for Veneering

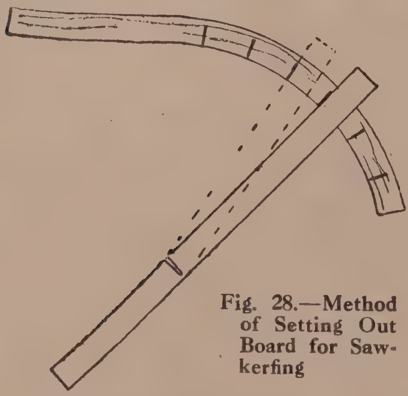


Fig. 28.—Method of Setting Out Board for Saw-kerfing

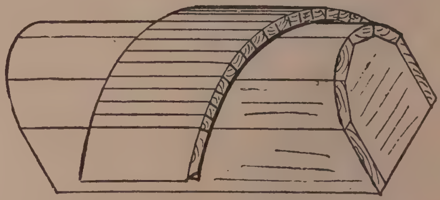


Fig. 29.—Method of Blocking Bent Veneers

When ready for rounding off, the ends should be marked with a pattern obtained from the drawing. The inside curve should be worked with a "round" plane

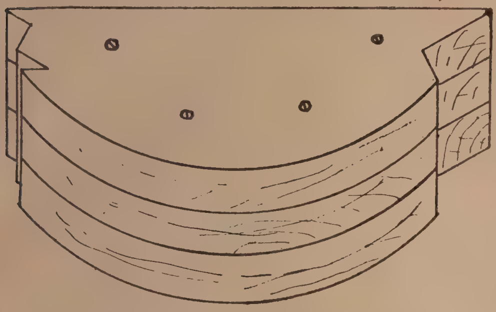


Fig. 30.—Blocks for Bull-nose Step

as wide as obtainable; or if many boards of this shape are to be made, an old jack plane might be rounded to fit the curve, and the cutting iron ground accordingly. A scraper could be ground to fit the curve for finishing before the glasspaper is used.

A stronger method of shaping by grooving and feathering the joints is shown by Fig. 25. After shooting the edges, plane a tangential surface at right angles to the joint sufficiently near to allow for finishing. Then plough the grooves as indicated about ½ in. or more in depth on each edge. Now cut off a number of feathers, obliquely, from a board the thickness of the grooves, as in Fig. 26. Cutting the tongues as feathers in this fashion allows the grain to cross the joint instead of longitudinally

Fig. 31.—Riser for Step Shaped for Binding

with the joint, which would be a source of weakness. The feathers should be shot sufficiently narrow so as not to bind and prevent the joint being rubbed close when gluing. The finished piece of work, as in Fig. 27, is then ready for veneering.

The curved work in connection with furniture is chiefly of an artistic character rather than geometrical, as in building construction. It consists of work composed of a number of curves which cannot always be set out geometrically, but are symmetrically constructed from a freehand design to one's artistic taste. Examples of such work can be seen in the art of chairmaking. There should be no difficulty in preparing a pattern of any fancy shape and making the required article, providing the piece is of the same thickness as the plank from which it is made. Should there be a double curvature on the piece to be made, the worker should ascertain the width and thickness from the drawing, showing the two views of the article. In the case of pieces forming the back of a chair, some will resemble pieces like the circle on circle, or, to be more correct, circle on cylinder, so that many

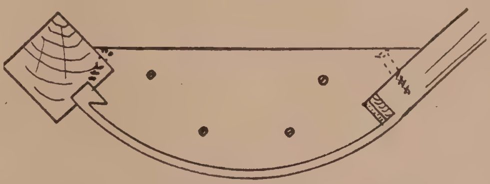


Fig. 32.—Bent Riser Fixed in Position

pieces have to be cut of cylindrical form for such work, and then the required circle or other pattern marked. The second curve or pattern is not always definitely marked on these cylindrical pieces until they have been approximately dressed to shape, fitted, and joined up temporarily by dowelling. Then the pieces are dressed to shape before gluing up.

The tools required for such work are the bow saw, spokeshave, smoothing and compass planes, the firmer chisel for paring the small convex surfaces, and the half-round file for finish-

ing. Two or three routers may be wanted for grooves, beads, and mouldings.

Saw-kerfing, as a method of bending boards, can be done in cases where there

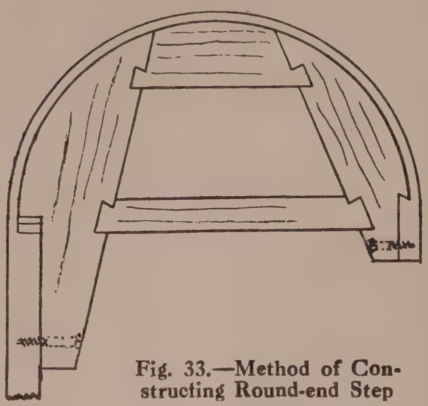


Fig. 33.—Method of Constructing Round-end Step

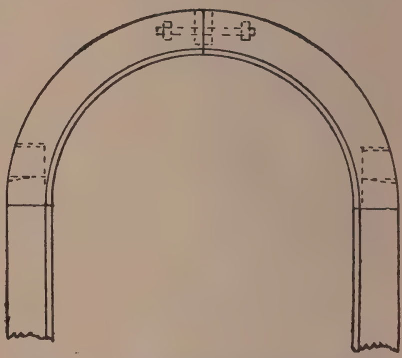


Fig. 34.—Method of Constructing Semicircular Door-head

is no great strain or stress on the board, and where these methods are pursued the board needs support from the adjacent fixings. Saw-kerfing on the concave side of a board for a convex or external finish requires care in making the cuts regular in depth and equidistant. Fig. 28 illustrates a method of approximating the distance apart of the saw cuts. A piece of wood, the same thickness as the board to be bent, is sawn nearly through or until it is sufficiently flexible to close in, and is then placed to the centre of the curve required. The movement round the circumference, in the operation of closing the cut, gives the space between the cuts on the board. The same saw must be used, and cuts to the same depth as in the test piece.

Veneers can be bent over a built-up cylinder or other shape, and blocks or strips of wood are fitted to the veneer and glued on, as in Fig. 29. This method is carried out in making the concave well hole of a staircase, in which instance the whole work is bound and strengthened by gluing canvas over the fillets or strips.

Reducing a board almost to the thickness of veneer, and by the aid of steam bending it round a block of wood, which is built up and made the required shape to give an external or convex curve, is a method sometimes employed. The lower risers of a staircase, such as a bull-nose, round end, or curtail step, are good examples of such work. For a bull-nose step, three or four pieces of thick boarding to

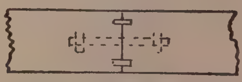


Fig. 36.—Method of Joining Curved Pieces of Door-head

Fig. 35.—Method of Joining Door Stile to Curved Head

the depth of the step are cut out reverse ways of the grain, glued, and screwed together (Fig. 30). The board for the riser, of about $\frac{7}{8}$ in. in thickness, is reduced to $\frac{3}{16}$ in. in thickness, in the portion to be bent, by planing. A splayed fillet of hardwood, to form a hook, is well secured by gluing and screwing, as in Fig. 31. After

the block has been fitted, the portion of the board for bending is well steamed, folded round, and secured by folding wedges. Screws are then fixed through the block to the thicker portion of the board. This is shown with the end housed into the newel post (Fig. 32). The block for a round-end step is sometimes made of four parts dovetailed together, and rounded off with saw, smoothing plane, and file. The wedging and screwing are performed in the same manner as the bull-nose step (Fig. 30).

An example of work where straight and curved pieces are joined together is shown by the semicircular head of a doorway (Fig. 34). Methods of joining the pieces together, and also on to the straight portion, are shown by Figs. 35 and 36. In the first a hammer-headed key is worked on the door stile in the solid, as shown in the side view. It is recessed to about three-fourths of the depth of the wood, and two wedges are required. This joint could be secured in the same way as the top joint (Fig. 36). The bolt has two nuts, one at each end, one being an ordinary nut and the other a circular one with notches on the edge, and these notches enable it to be tightened with a small cold chisel. The holes are bored in the end of each piece forming the joint; the nuts are let in from the top side and a washer must be used with the circular nut. The joints are kept flush by means of two cross tongues, as shown in the plan of the joint (Fig. 36). These methods are the most common practice in curved work.

Cramps and Cramping

When assembling work, especially furniture, it is often necessary to have recourse to mechanical aid for the purpose of forcing the joints together, or for holding them during such time as the glue is setting, or nails, screws, pins or wedges etc., are being inserted. Appliances used for this purpose are termed cramps, and they are made in a very extensive range of patterns which gives them a wide field of application. Not only are they of use during the fitting together of work, but frequently also whilst it is being shaped.

Improvised Cramps.—Formerly it was the custom to improvise wooden cramps, but now most workshops are equipped with a good supply of the various kinds of metal cramps, which saves the time of making wooden cramps, though to the amateur or the craftsman in a small way of business improvised cramps often supply a temporary need which would not warrant the purchase of a metal cramp.

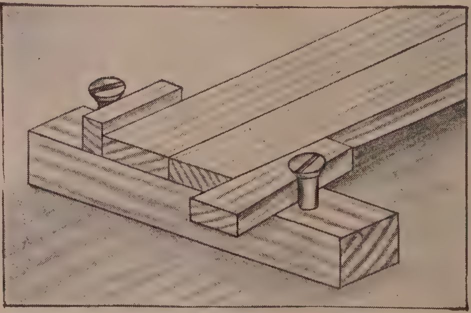


Fig. 1.—Improvised Cramp for Strips of Wood

Fig. 1 shows a cramp improvised for the purpose of holding together strips of wood that have been glued. It is made by driving two stout nails—or, better for most purposes, screws—into a strip of wood at a distance apart which is rather more than the width of the two pieces of wood that are to be held together. A wedge is then driven tightly to hold the joint together as indicated in the illustration.

It often occurs that a strip of hardwood has to be glued to a softwood piece. After being glued the two can be held firmly together until the glue sets by small cleat cramps and wedges at frequent intervals as clearly shown by Fig. 2. When it is desired to hold several boards together until the glue is dry, the cramps should be arranged alternatively on the front and back of the boards, as shown by Fig. 3, so as to prevent them from buckling forward which they tend to do.

Fig. 4 shows a good method of forcing together the edges of floorboards ready for nailing. A batten is nailed or screwed to two or three joists, and a piece of wood is placed against the edge of the front floorboard as shown. Wedges are then driven until the joints of the boards are up close. When it is required to glue and "wedge up" a number of sashes or light doors, a pair of wooden cramps may be made and fixed

to a bench, as shown in Fig. 5. In making this cramp it is important that the back of the mortise and the splayed end of the cleat should be in the same plane so that

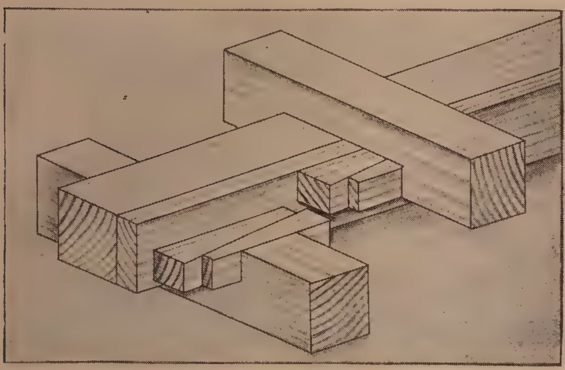


Fig. 2.—Another Form of Improvised Cramp for Strips

the edge of the wedge may fit close to them. This will be understood from Fig. 6.

Another improvised cramp is shown by Fig. 7. This is a very simple and well-known form of cord or rope cramp, and is suitable for holding together the mitred joints of a frame until the glue has become properly set. The same principle of the twisted rope will suggest itself to a number of other applications, such as the holding together of boards placed edge to edge, etc. A piece of iron rod should be used to twist the rope in such a case as the latter, and when this is sufficiently taut the rod can be tied in position.

Wooden Screw Cramps.—Fig. 8 shows a very useful form of small wooden screw cramp suitable for holding together small work. The head and shoe is double-tenoned and mortised to the back, and to give further strength an iron rod provided with a nut at each end passes right through as shown. This cramp is the prototype of the common form of iron **G**-cramp, and which has largely taken its place

A long bar cramp made of wood, and which used to be very largely used, especially by cabinet-makers, is shown by Fig. 9. This also has been almost entirely superseded by the light steel sash cramp described later on. Two methods of attaching the screw head firmly to the bar are shown by Figs. 10 and 11. In Fig. 10 it will be seen that a metal strip that embraces the screw head is used. The alternative method (Fig. 11) is by means of a bolt and nut. As is clearly shown, the nut is let into the bar from the top, a hole having previously been drilled longitudinally to meet it.

When cramping up thin flat work it is usually necessary to provide some means of support or stiffener in order to prevent the stuff buckling and doubling up. In addition to a support being necessary it is essential that the jaws of the cramp should work parallel to each other. A cramp that fulfils these conditions is shown by Fig. 12. It can be suitably used for thin panel material or light framing. Adjustment for large or small work is provided by the series of peg holes in the longitudinal bars.

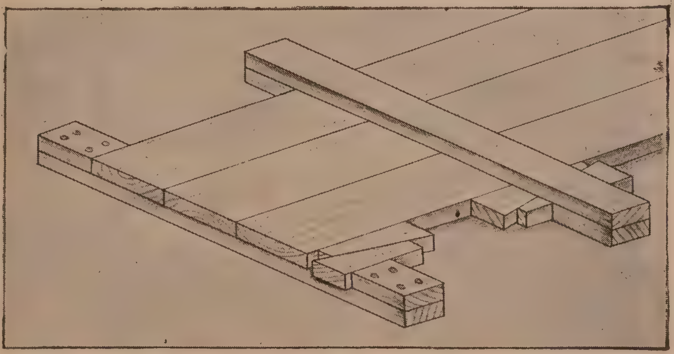


Fig. 3.—Improvised Cramp for Boards

Probably the form of wooden screw cramp most commonly used at the present

day is the double-jaw hand-screw shown by Fig. 13. This form of cramp lends itself to such a variety of purposes and is so simple of application that it has never been ousted by the metal cramps. A modification and improvement of this type of cramp is the Jorgensen hand-screw snown by Fig. 14. This is so made that the jaws can be operated at various angles, a feature extending the scope of its application to cramping surfaces whose edges are not parallel.

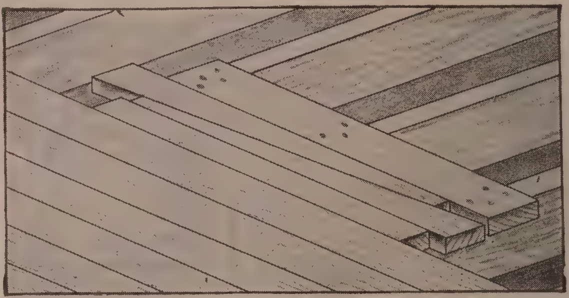


Fig. 4.—Simple Method of Cramping Up Floorboards

A very good form of gig cramp for use when it is required to have curved parts built up of two or more thicknesses of wood is shown by Figs. 15 and 16. The thin layers of material are glued and bent, forced into and held in position, as shown in Fig. 16. The bent piece of work is shown by Fig. 17. It will be noticed that the bolts are long and have screw threads on for at least half their length.

Metal Cramps.—The most commonly used metal cramp is the ordinary **G**-cramp shown by Fig. 18. This type is so well known that it needs no description. A couple of instances of its use are given later, and as it can be adapted to such a variety of situations, further suggestions are unnecessary. The same remarks also almost apply with regard to the bar or sash cramp. Three patterns of this type of cramp are shown by Figs. 19, 20 and 21. The first has a **T**-section bar, and one jaw of the c ramp is made adjustable by means of a metal peg which can be inserted in holes drilled at intervals in the bar. Adjustment of the other two forms is provided by means of a toothed bar and wedge and the difference between these two latter lies in the section of the bar. Fig. 22 shows an extension piece suitable for fitting on a cramp provided with a **T**-section bar and peg-holes. A pair of fittings, which are so designed that they can be fitted on a bar of wood and thus make a useful bar cramp, are shown by Fig. 23.

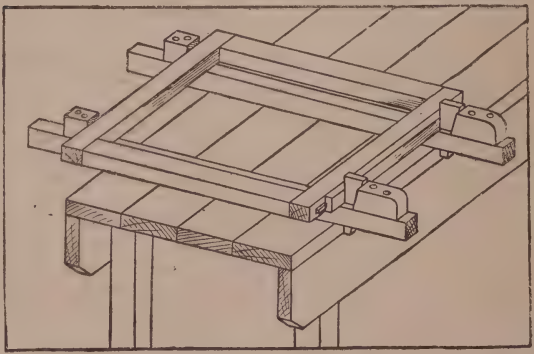


Fig. 5.—Application of Wedge Cramp for Light Framing

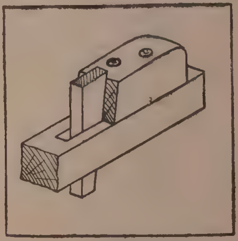
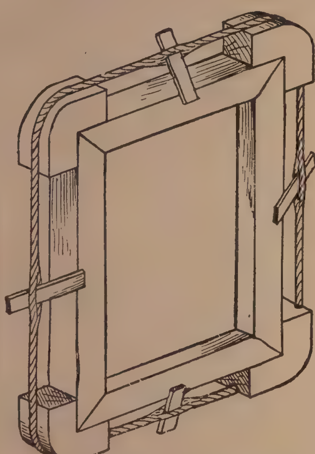


Fig. 6.—Wedge and Cleat

Figs 24 and 25 show two forms of bench holdfast primarily intended for holding work down on the bench, though various other uses for them will suggest themselves according to the nature of the work in hand. In each case the post of the appliance is inserted in a hole in the bench, and a binding action, due to side pressure which results when the work is clamped, holds it firm. It will be seen that the arm of Fig. 25 has a variable reach.

When glue jointing short boards of $\frac{3}{4}$-in. and upwards thickness, iron dogs, as they are usually called, are very useful. As will be seen by Figs 26 and 27 the ends are tapered inwards so that as they are driven in they draw the joint together. They have to be used carefully as they tend to split the wood. Fig. 28 clearly shows the manner in which they are used. Fig. 29 shows an ordinary kind of mitre cramp much in favour. The principal



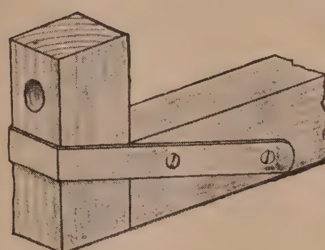


Fig. 10.

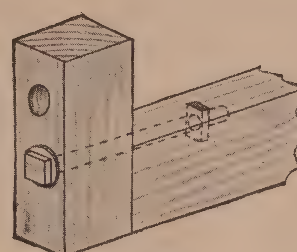


Fig. 11.

Figs. 10 and 11.—Methods of Attaching Head on Bar Cramp

Fig. 7.—Application of Rope Cramp to Frame

Fig. 9.—Wooden Bar Cramp

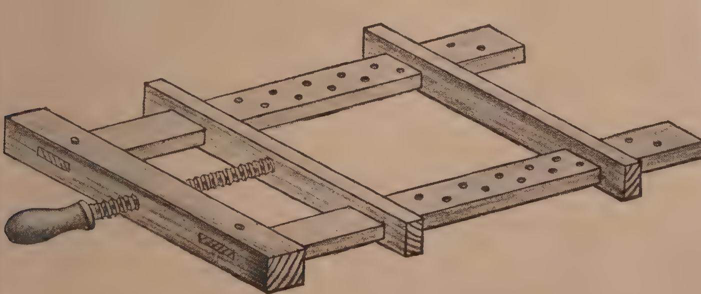


Fig. 12.—Wooden Panel Cramp

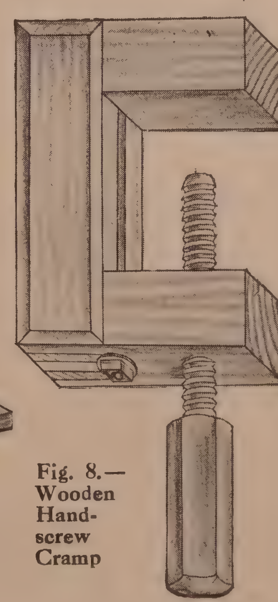


Fig. 8.—Wooden Hand-screw Cramp

advantage of this form of cramp is that the joint can be screwed or nailed whilst being firmly held together by the cramp. The manner of its use is shown by Fig. 30. Fig. 31 illustrates a good kind of cramp now on the market for cramping up the four mitres of a frame at once. It can be quickly adjusted to any size frame within its limits.

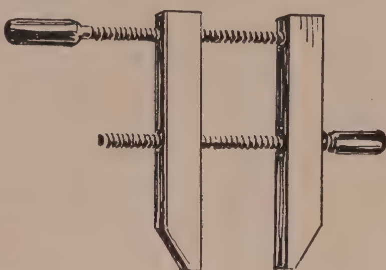


Fig. 13.—Double Handscrew Cramp

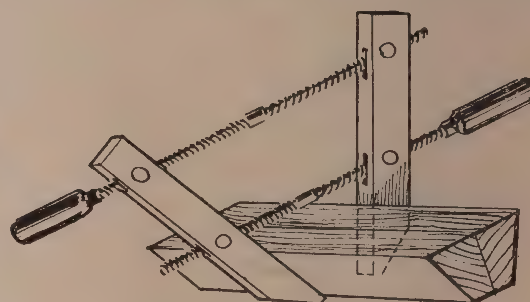


Fig. 14.—Jorgensen Cramp

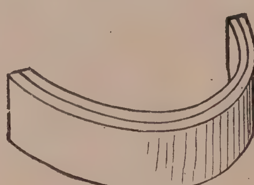


Fig. 17.—Work after Removal from Gig Cramp

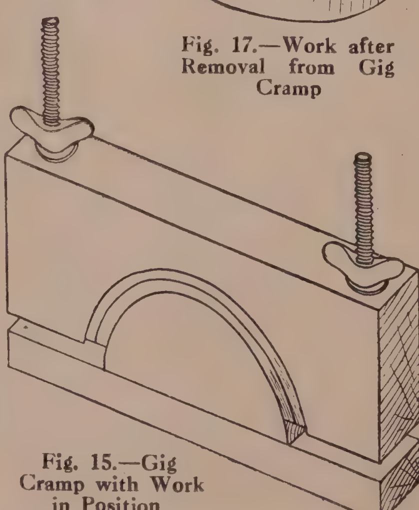


Fig. 15.—Gig Cramp with Work in Position

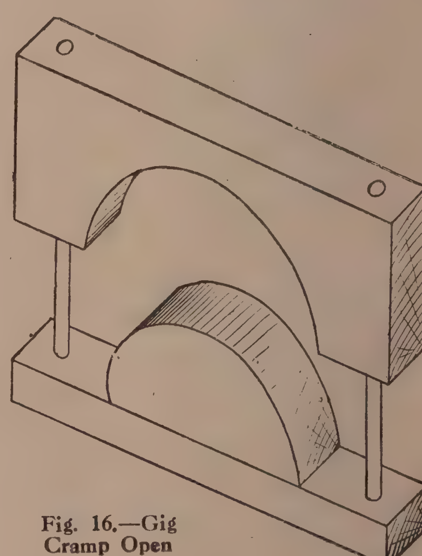


Fig. 16.—Gig Cramp Open

Cramping.—The simpler applications of cramps are so obvious that no useful purpose would be served in detailing them, but a few examples are given here of methods which perhaps would not readily suggest themselves. In addition to the cramp itself it is sometimes necessary to employ improvised accessories for a particular piece of work. Such a case is illustrated by Fig. 32, which shows an ordinary **G**-cramp being used to cramp the

joints between the curved rails and legs of a small table or stool. Two hardwood cleats are made of a shape similar to that shown in Fig. 33. Then a piece of hoop-iron of the proper length is drilled and countersunk for screws at each end, and then fixed to the cleats as shown. Somewhat similar is the method of cramping up the end of a couch or article of like form by means of a hoop-iron band and

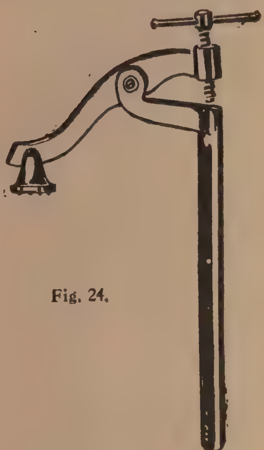


Fig. 24.

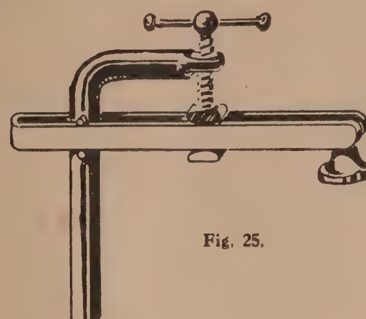


Fig. 25.

Figs. 24 and 25.—Bench Holdfasts

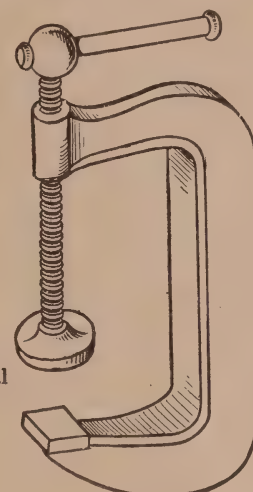


Fig. 18.—Metal G-cramp

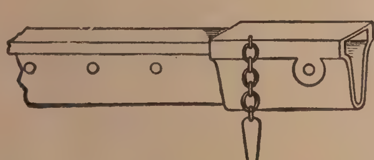


Fig. 22.—Extension Piece for Bar Cramp

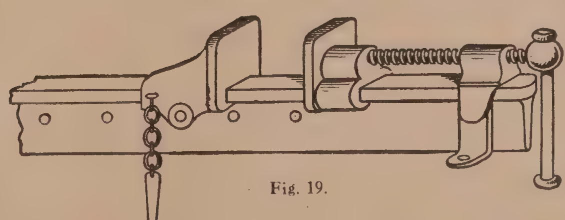


Fig. 19.

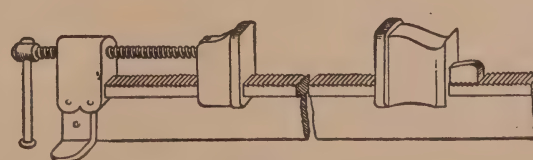


Fig. 20.

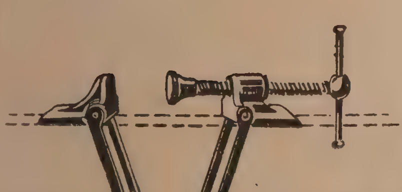


Fig. 23.—Attachments for Bar to Form Bar Cramp

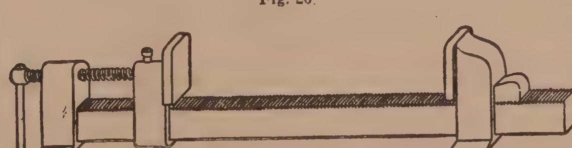


Fig. 21.

Figs. 19, 20 and 21.—Three Forms of Bar or Sash Cramps

Fig. 26.

Fig. 27.

Figs. 26 and 27.—Two Forms of Iron Dog Cramps

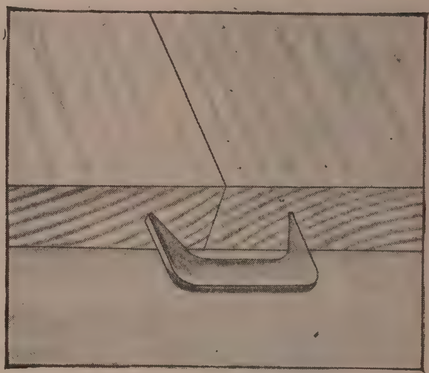


Fig. 28.—Method of Using Dog Cramps

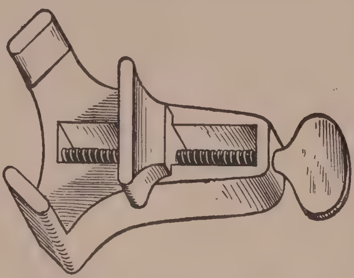


Fig. 29.—Screw Mitre Cramp

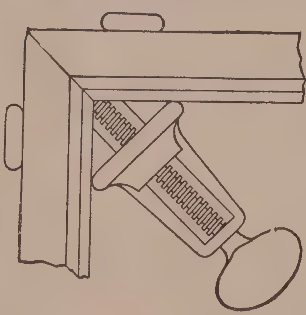


Fig. 30.—Application of Screw Mitre Cramp

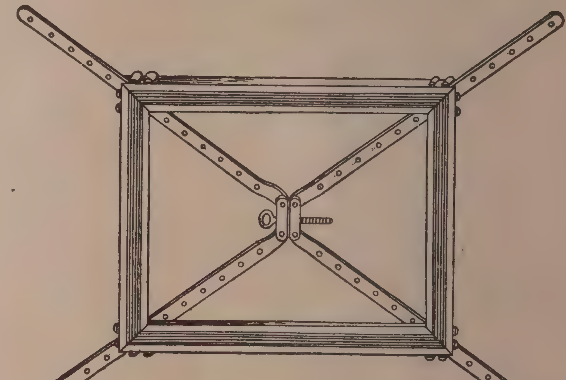


Fig. 31.—Application of Four-corner Mitre Cramp

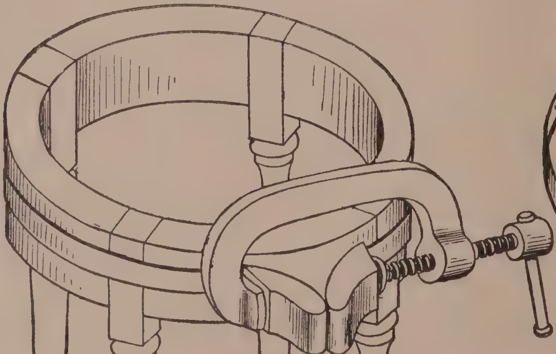


Fig. 32.—Method of Cramping Small Table by means of Iron Band and G-Cramp

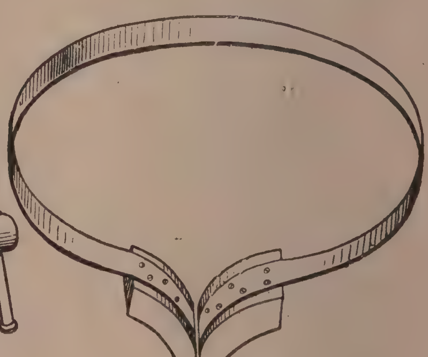


Fig. 33.—Iron Band with Cleats Attached

cleats which are held by a long iron or wooden cramp fastened on each side as illustrated (Fig. 34). Flexible iron bands are also useful under conditions such as are illustrated by Fig. 35. The band should be a piece of hoop-iron 1 in. to $1\frac{1}{2}$ in. wide. The shanks of a couple of $\frac{1}{2}$ in. bolts are filed partly flat or sawn down for

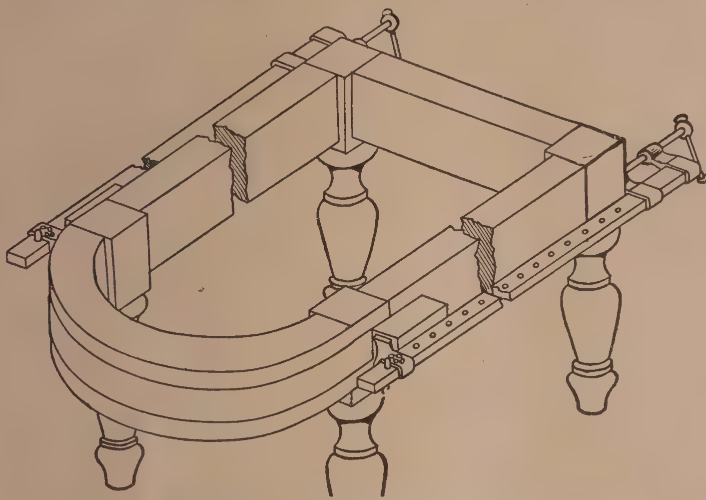


Fig. 34.—Method of Cramping Sofa-end by means of Bar Cramp and Iron Band

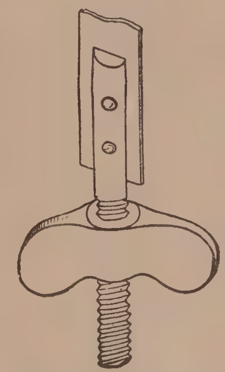


Fig. 36.—Details of Thumb-screw

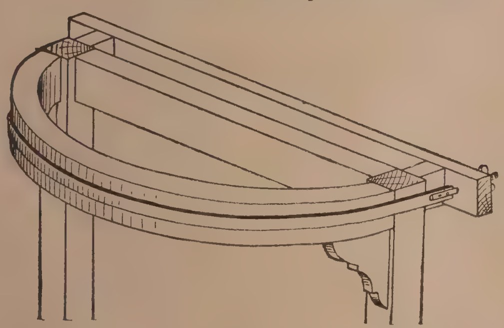


Fig. 35.—Simple Application of Iron Band and Thumb-screw for Circular Work

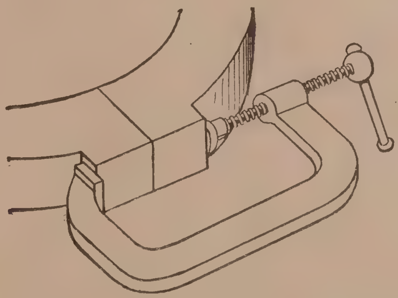


Fig. 38.—Use of G-Cramp for Circular Work

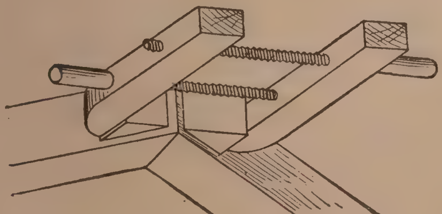


Fig. 39.—Cramping Mitre Joint by means of Double Hand-screw Cramp

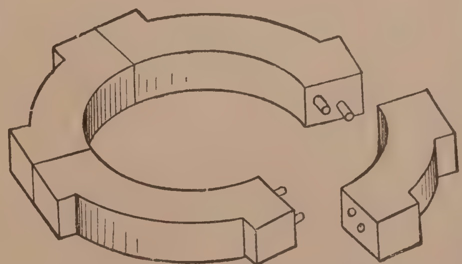


Fig. 37.—Details and Shape of Circular Frame before Cramping

about two inches with a hacksaw. These are placed on to the ends of the hoop-iron and holes are drilled through each and rivets inserted; this will be understood by reference to Fig. 36. Ordinary nuts with a spanner may be used, but good size wing nuts will be found more convenient.

When jointing up circular pieces of framing, similar to that shown by Fig. 37, it is a good plan to cut out the pieces with projecting horns as illustrated. Then the joints should be made and dowelled, after which they can be glued and held firmly by means of G-cramps as shown by Fig. 38. When the glue is set the horns can be cut off and the frame finished.

Fig. 39 shows a good method of cramping up a mitre by means of a hand-screw; two blocks of wood are cut to shape and glued on and allowed to stand for a few hours; the joint is then glued and cramped up close and held until the glue is properly set.

Simple Book-racks and Book-shelves

COLLAPSIBLE SLIDING BOOK-RACK

A USEFUL book-rack suitable for table use, and designed to accommodate varying numbers of books and at all times to keep them in an upright position, is shown by Fig. 1.

The choice of the kind of wood to use is a matter of individual taste, but preferably it should be hard. The quantities of materials required would be as follows: Base, 1 ft. 10 in. by 10 in. by 1 in. thick; sides, 2 ft. by 9 in. by $\frac{3}{4}$ in. thick; four brass cabinet hinges 1 in. wide; two dozen $\frac{1}{2}$-in. brass screws; a piece of 1-in. by $\frac{1}{16}$-in. strip brass 1 ft. long, similar to that used for bent metalwork.

To make the book-rest, the piece of wood 1 in. thick is sawn into three strips, two of which should be $2\frac{1}{2}$ in. wide and one 5 in. wide. These will be seen on reference to Fig. 2. They are then planed true to the finished dimensions, and the two pieces forming the sides grooved, as shown in Fig. 3. The centre portion or slide is

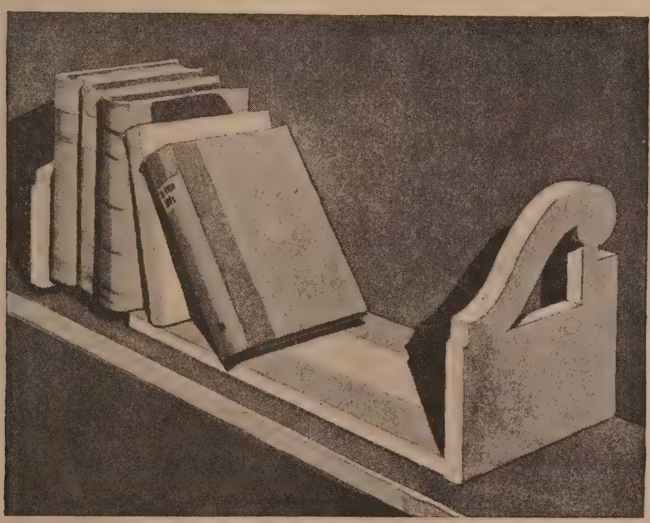


Fig 1.—Collapsible Sliding Book-rack

rebated four times or sunk at each of its edges (*see* Fig. 3). These operations are carried out usually with tenon saw, chisel, mallet, and rebate plane. The pieces should fit tightly but easily into each other. However, should they stick or jar, a little ordinary blacklead (as used in the cleaning of fire-grates) applied to the grooves and slide will help matters considerably.

It can be cut out by means of a bow saw, finished on the outside with a spokeshave, and pared down on the perforation and small parts with a chisel all kept true or square to the surface.

The preparation of the sides for the other style consists simply of planing the wood true to the sizes given, perforating the diamond pattern with the brace and centre-bit and paring down with a sharp

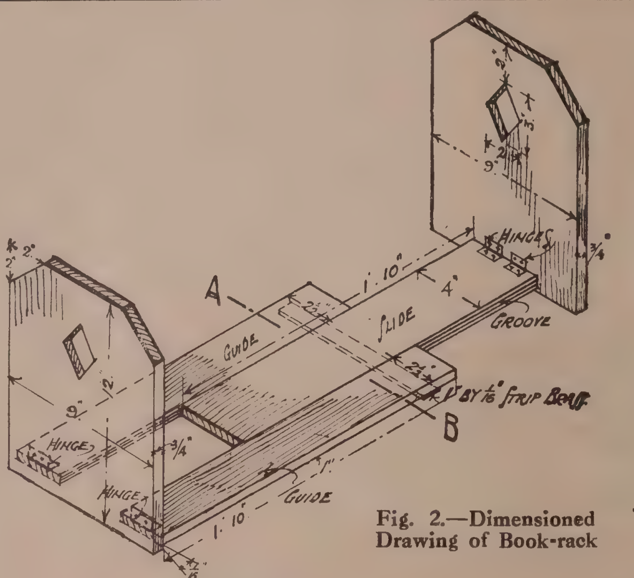


Fig. 2.—Dimensioned Drawing of Book-rack

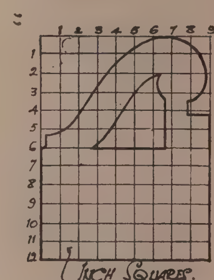
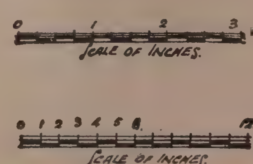


Fig. 4.—Method of Producing Shaped Ends of Book-rack



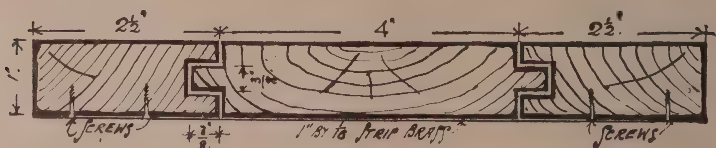


Fig. 3.—Section of Base of Book-rack

Alternative designs for the end pieces are shown, one style being that shown by the photograph, and the other in the dimensioned drawing (Fig. 2). The first design for the ends is shown by Fig. 4, and it will be seen that it is produced in a series of 1-in. squares to enable it to be drawn in outline on the piece of wood by following the intersections of the curves on same.

bevelled-edge chisel. The corners are cut off to 2 in. each way. The hinging of the sides to the guides and slide is shown in Fig. 2, and it will be noticed that they project $\frac{1}{16}$ in. below the base to compensate for the thickness of the strip of brass introduced to prevent the guide from spreading or getting out of position. Obviously this allows the rest to stand evenly. The brass

is drilled and screwed to the underside of the guides, the former being done with an archimedean drill. For convenience of packing away, the dimensions of the sides are so arranged that they will fall exactly on to the base, and so occupy the least possible space.

EASILY-MADE HANGING BOOK-RACK

The book-rack shown by Fig. 5 has been specially designed to accommodate the ordinary low-priced pocket novel. Its construction is simple, and makes but moderate demands in the way of skill and tools, and if neatly made will form a useful article of furniture for the wall or mantel-shelf.

The top is of $\frac{5}{8}$-in. stuff; the sides, shelf, and brackets are of $\frac{1}{2}$-in. stuff (finished thicknesses); and the back is of three-ply or fretwood $\frac{1}{8}$ in. thick. It may be made of pine or clean sound deal, and painted and enamelled any colour; or any furniture hardwood, such as oak, walnut, or mahogany, may be used, and the job either left clean or french-polished as desired.

All dimensions are indicated on the working diagrams (Figs. 6 to 10). The material required for the job is as follows: Top, 2 ft. 6 in. by $6\frac{3}{8}$ in. by $\frac{5}{8}$ in.; shelf, 2 ft. 3 in. by $5\frac{1}{2}$ in. by $\frac{1}{2}$ in.; sides (to cut two), 1 ft. $10\frac{1}{2}$ in. by $5\frac{1}{2}$ in. by $\frac{1}{2}$ in.; brackets (to cut four), 1 ft. by 9 in. by $\frac{1}{2}$ in.; back (including slight allowance for trimming), 2 ft. by 1 ft. by $\frac{1}{8}$ in. There will also be required a few $1\frac{1}{2}$-in. and $\frac{5}{8}$-in. wire brads, and four 1-in. No. 6 screws. The four ornamental side brackets (Fig. 9) should be fret-sawn to shape and perforated, and the lower or wedge part left rather more than the figured size of $\frac{5}{8}$ in. wide to allow for subsequent fitting. Two tenons are formed at each end of the shelf as shown, and these project through corresponding mortises cut in the sides of the book-shelf, to which the shelf is secured by means of the bracket wedges passing through the slots made in the shelf tenons. The dimensions for these tenons and slots are given on the plan and side views (Figs. 7 and 8), and in fitting the

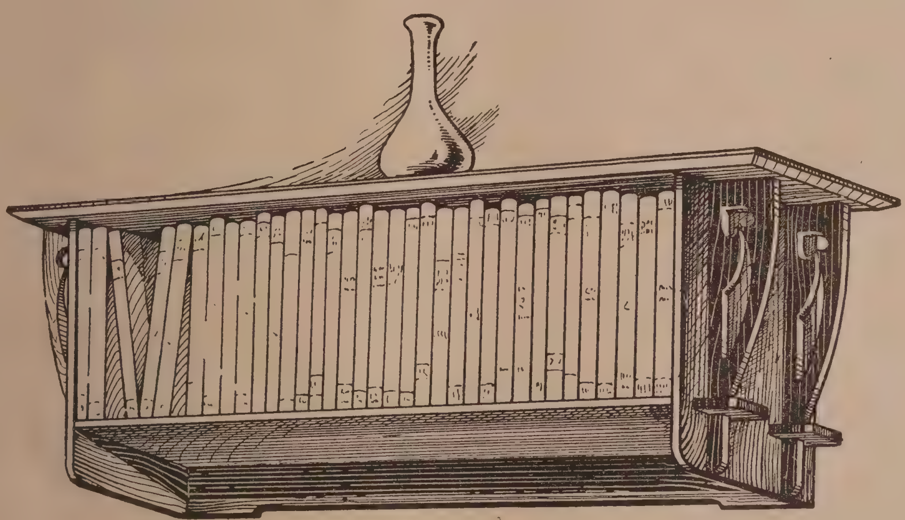


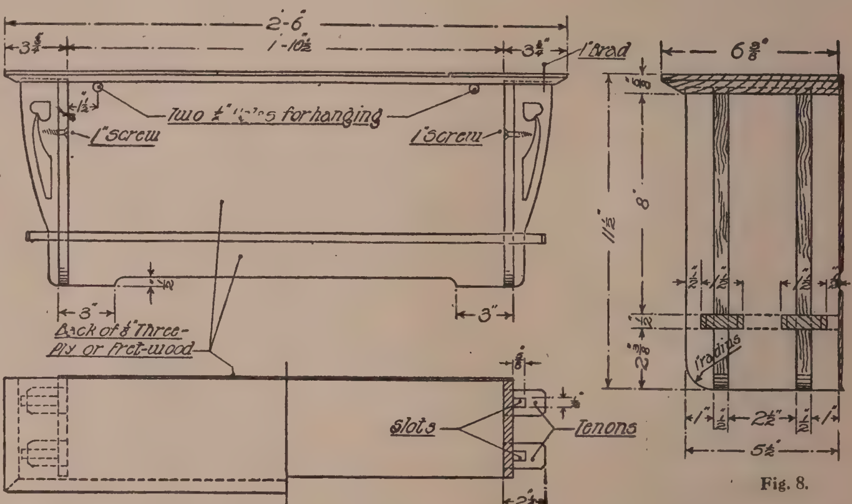
Fig. 5.—Hanging Book-rack

brackets the lower portion should be slightly tapered, so that when gently tapped home in the slots they will act as wedges and draw the shelf and sides tightly together. If this fitting is carefully done no other fixing at this part will be necessary. One 1-in. No. 6 screw placed in each bracket where indicated in the front view (Fig. 6) will completely secure these useful overmantel members in position after they are well home in the slots.

driven through the top into each bracket, a hole being first bored with a bradawl for these particular brads, to avoid the risk of splitting the brackets. Of course, the top can only be put on after the shelf, sides, and brackets are all assembled. This done, the only part of the job remaining is the preparing and fixing of the back, and before beginning this take a try-square and see that the book-rack is "square," that is, the shelf and top must form a right angle with the sides. Then lay the book-

Fig. 6.

Fig. 7.



Figs. 6, 7 and 8.—Front Elevation, Plan and Vertical Section of Hanging Book-rack

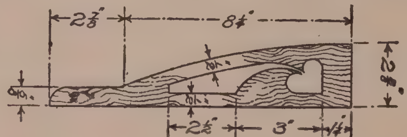


Fig. 9.—Ornamental Side Bracket

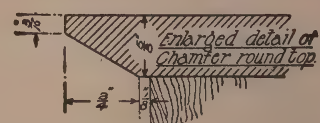


Fig. 10.—Enlarged Detail of Top

The top of the book-rack is chamfered off on the front edge and two ends (*see* enlarged detail, Fig. 10). The upper ends of the two sides and of the four brackets should be housed (let in) to the top to a depth of $\frac{1}{4}$ in. (*see* dotted lines in the front and side views, Figs. 6 and 8), and secured by means of glue and some of the $1\frac{1}{2}$-in. wire brads. One of these brads should be

rack down with its back edges flat on the $\frac{1}{8}$-in. three-ply or fretwood, mark with a pencil round the outside of the sides and top to get the exact outside size; also mark off the positions of the two $\frac{1}{2}$-in. holes ror the nails on which the book-rack is to hang, and the simple shaped piece at the bottom edge. Cut the back to the pencil lines, bore the two holes, and saw

out the shaping, and fix the back in position on the back edges of top, shelf, and sides with the $\frac{5}{8}$-in. brads spaced about 2 in. apart. The whole will then be perfectly rigid.

If it is decided to finish off with paint and enamel, the brads in the top should be punched about $\frac{1}{8}$ in. below the surface, and these brad-holes stopped with putty after the first coat of paint has been applied. Two coats of paint, followed by a coat of enamel, will give a very satisfactory finish, except in the case of white or cream being selected, in which case the enamel should be preceded by three coats of paint. It is advisable to omit the enamel from the inside of the book-rack, as books are always inclined to stick on enamelled surfaces.

SMALL PARTITIONED BOOK-RACK

Another book-rack suitable for the accommodation of the smaller-sized odd volumes which frequently lie about the house; or for the purpose of keeping a few favourites close at hand, is shown by Fig. 11. Front and end elevations and plan are shown by Figs. 12, 13 and 14 respectively.

The shelves and the four upright members are finished $\frac{3}{8}$ in. thick, the top is $\frac{7}{8}$ in. thick, and the back panel is of $\frac{1}{8}$-in. fretwood. The three shelves are housed, glued, and bradded to the uprights, the housings being stopped $\frac{3}{8}$ in. from the front edge of the latter. A detail of the central shelf is given (Fig. 15), from which it will be seen that it is shaped and moulded on its front edge. The moulding is similar to that detailed for planting on the side shelves and is returned on to the edge of the uprights. Housings are formed in the top to receive the ends of the uprights, these housings being stopped $1\frac{7}{8}$ in. back from its front edge, which together with the two ends is moulded as detailed. The back edge is rebated for the back panel, as are also the two outside uprights, and is attached to all the back

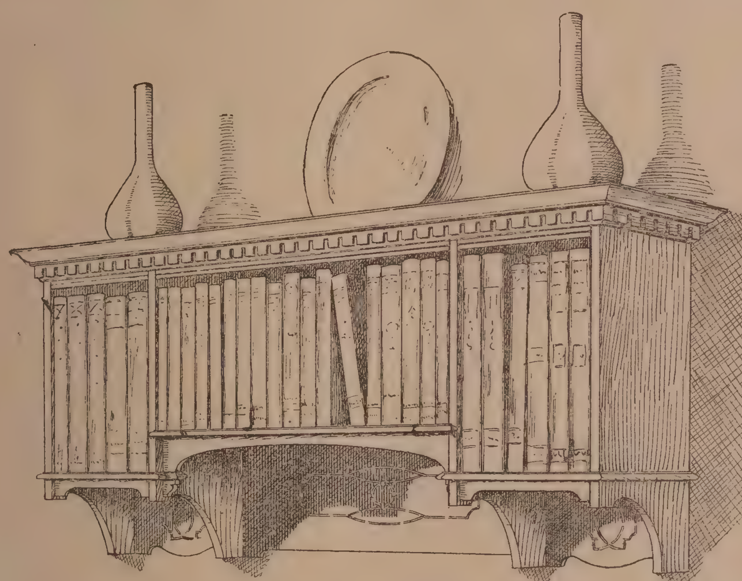


Fig. 11.—Small Partitioned Book-rack

edges of the bookcase with brads. The top rail, finished with a $\frac{1}{4}$-in. bead, is let in flush with the front edge of uprights, and here it should be noted that the joint where this rail is let in should be so arranged as to be concealed by the cornice moulding when this is in position. A portion of the cornice moulding is shown broken away in the front view to make this point clear.

the exact length of the front and ends, but they should be approximately $\frac{1}{2}$ in. wide with spaces $\frac{1}{4}$ in. wide between. The spandril piece under the central shelf (Fig. 16) is $\frac{1}{4}$ in. thick, and is fixed $\frac{3}{8}$ in. back from the front edge of the upright with glue and pins and some small angle-blocks. There are, in addition, spandrils under the side shelves, but they are only $\frac{1}{8}$ in. thick and are set back $\frac{1}{8}$ in. only, and

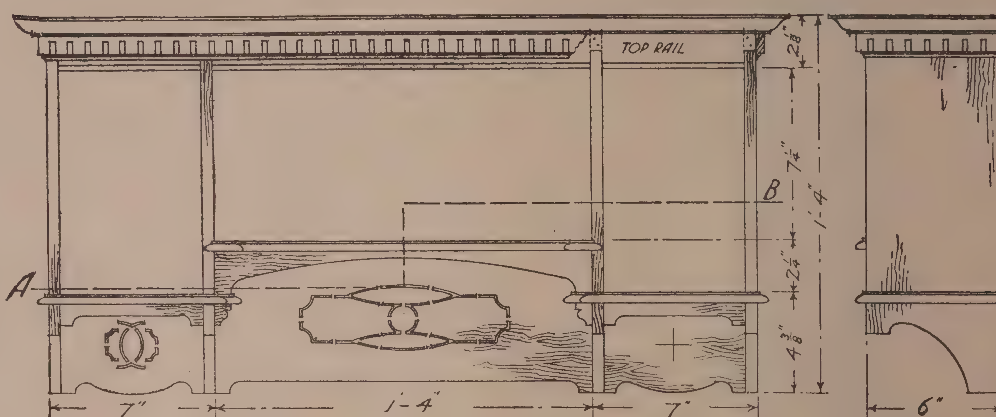


Fig. 12. Fig. 13.

Figs. 12 and 13.—Front and End Elevations of Partitioned Book rack

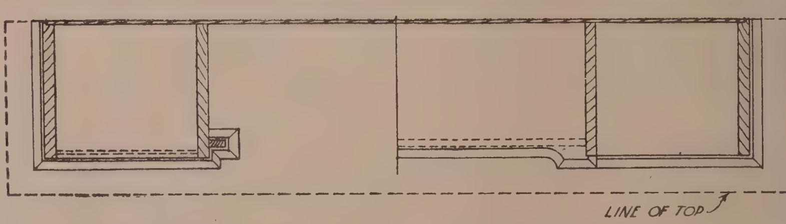


Fig. 14.—Plan of Partitioned Book-rack on Line A–B (Fig. 12)

On reference to the detail of the top and cornice moulding (Fig. 17), it will be seen that the latter is made in two pieces. The dentils are formed on the $\frac{11}{16}$-in. by $\frac{5}{16}$-in. strip by first rebating out and moulding the lower portion, and then cross-cutting the upper part with a fine saw, removing the spaces between the blocks with a $\frac{1}{4}$-in. chisel. The $\frac{5}{16}$-in. by $\frac{3}{16}$-in. slip C is then glued on to complete the moulding. Care must be taken to set the dentils out to suit

are glued and pinned in place as before. A small moulding, as detailed (Fig. 18), is glued and pinned to the front edge of the side shelves, and is carried round the ends of the bookcase and mitred round the lower portions of the central spandril piece, as shown in the sectional plan.

The curved parts and fretwork are given in a detail (Fig. 16) set out on $\frac{1}{2}$-in. squares. The design in the back panel is formed by perforations $\frac{1}{8}$ in. wide, and is

afterwards backed with red silk. For convenience in fretting out the design, the back panel should be made in two pieces, the joint being arranged to come behind the central shelf.

Figured oak would be very suitable stuff to use; preferably it should be stained black with ebony stain and wax-polished, the grain being left open and not filled. The coloured bindings of the books, and some blue and white china ornaments, all combine to make the bookcase an attractive little feature of the room.

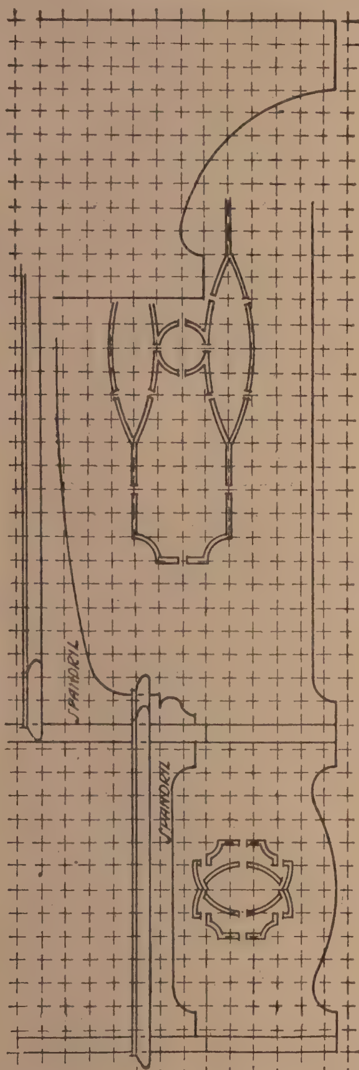


Fig. 16.

Fig. 15.

Figs. 15 and 16.—Method of Obtaining Shapes of Centre Shelf and Front and Ends of Partitioned Book-rack

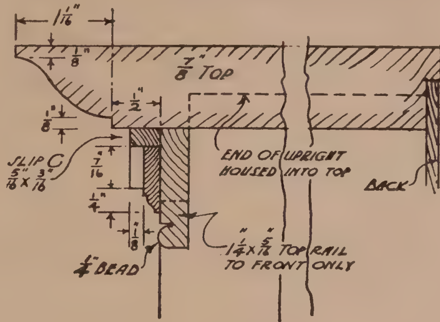


Fig. 17.—Detail of Top and Cornice Moulding

BOOK-RACK WITH CARVED OR MODELLED ORNAMENT

The book-rack shown in front and side elevations and plan by Figs. 19, 20 and 21 is designed to interest those readers whose constructional capabilities allow of them enriching their work by means of carving or gesso. The subject of wood-carving is dealt with in a later section.

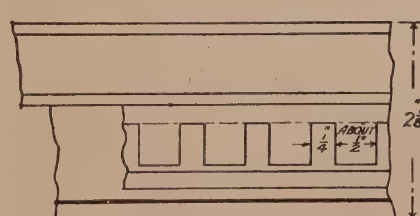


Fig. 18.—Detail of Moulding for Side Shelves

The shelves comprise sides, a thin back shaped at the bottom, as at A (Fig. 19), a top with moulded projecting edges, a

square bottom shelf B, and two small intermediate ones shaped on plan, as at C (Fig. 21). Under the top and bottom shelves are apron-pieces, finished along the lower edges with planted beads and decorated by means of simple geometric fretwork $\frac{1}{16}$ in. thick, glued on, the enclosed grounds being punched lightly as shown. The scroll-ends (Fig. 22) and pediment (Fig. 23) can be carved in the ordinary manner or roughly shaped and finished in gesso, in which latter case white enamel might appropriately be used as a finish to the whole.

BOOK-SHELVES FOR RECESS

The recess usually found on each side of a fire-place is a convenient position for setting up the book-shelf fitment as illustrated in Fig. 24. Moreover, another advantage is that this posi-

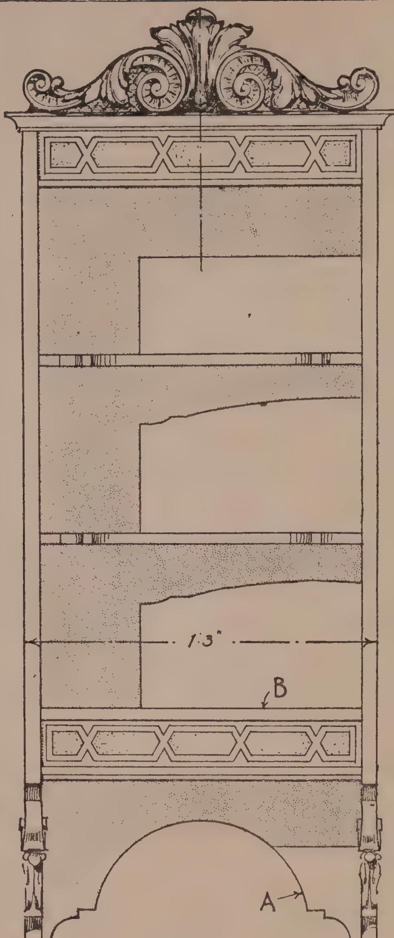


Fig. 19.

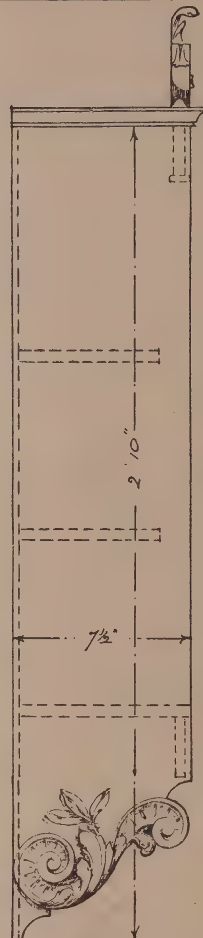


Fig. 20.

Fig. 21.

Figs. 19, 20 and 21.—Front and Side Elevations and Plan of Book-rack with Carved Ornament

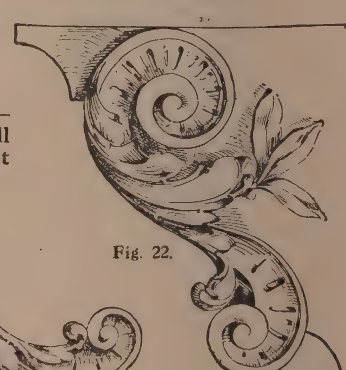
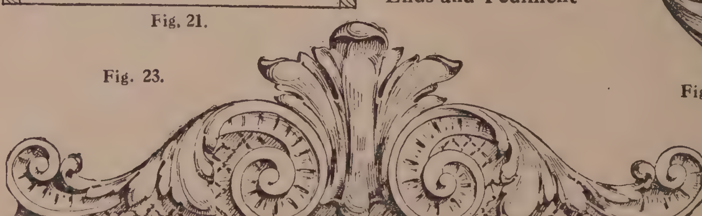


Fig. 22.

Fig. 23.



Figs. 22 and 23.—Designs for Scroll Ends and Pediment

tion is generally the driest in the room. The design given is of quite a simple character, for the entire construction can be made without mortise-and-tenon or dovetail joints, enabling the whole to be readily taken apart for removal. The timber suggested is American whitewood "faced up" with walnut or some other hardwood, such as oak or mahogany.

Fig. 25 is a front elevation of the fitment in a recess 3 ft. 9 in. wide and 1 ft. 2 in. deep, with a total height of 6 ft. 9 in. from the floor to the top of the cornice; but these dimensions may be modified to suit a larger or smaller opening. If the room has a picture moulding, a good plan is to make the top of the cornice to line with the under edge of the moulding. It will be clear from the sectional view (Fig. 26) that the fitment is arranged in two parts. The lower portion, which is $11\frac{1}{2}$ in. deep and 3 ft. 3 in. high, terminates at the moulded shelf, and provides accommodation for large bound volumes, atlases, etc. The upper portion is made $7\frac{1}{2}$ in. deep for the smaller books. For the lower sides, prepare two pieces of whitewood each 3 ft. 2 in. by $10\frac{7}{8}$ in. by $\frac{3}{4}$ in., and proceed to tongue and groove to the front edge of each a strip of walnut $1\frac{3}{4}$ in. wide and $\frac{7}{8}$ in. thick, as indicated in Fig. 27. This piece of walnut, besides improving the appearance, facilitates the fitting of the sides to any irregularities in the walls. The pilasters cause a space of 1 in. between the sides and the walls, which is easily filled by screwing two battens each $10\frac{1}{2}$ in. by $1\frac{1}{2}$ in. by 1 in. to the back of each side.

For the moulded shelf, which forms the division between the upper and lower portions, plane a piece of walnut 1 ft. $\frac{1}{2}$ in. wide and $\frac{7}{8}$ in. thick, and, after moulding the front edge, glue and screw to the underside a 2-in. strip of walnut to form an under moulding. Carefully cut this shelf to fit between the walls, and notch a piece from each of the upright sides to make room for the under moulding; a detail is shown by Fig. 28.

The sides of the upper portion are made in a similar manner to the lower sides, the whitewood being cut to 3 ft. $5\frac{5}{8}$ in. long and $6\frac{7}{8}$ in. wide before being tongued to the pilasters. It will, however, be observed, as shown in Fig. 29, that the whitewood sides project $3\frac{5}{8}$ in. above the tops of the pilasters, in order that the tongues may receive the cornice front. This cornice

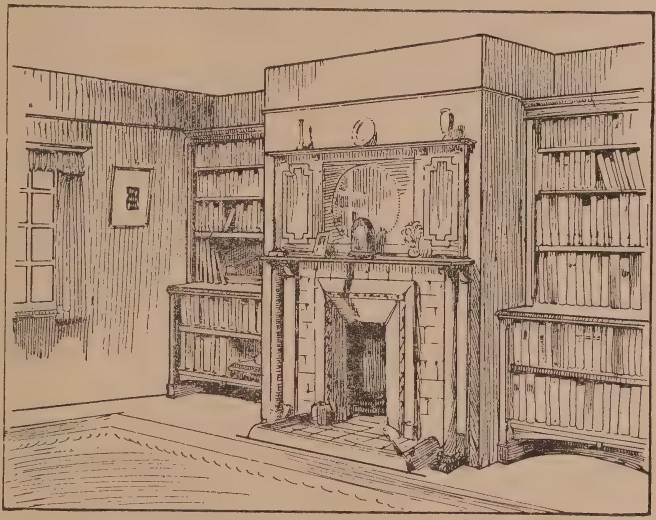


Fig. 24.—Book-shelves for Recess

consists of a length of whitewood $3\frac{3}{8}$ in. deep by $\frac{5}{8}$ in. thick, "faced up" by gluing on lengths of walnut moulded to the section given in Fig. 30. Notice that the top moulding projects $\frac{3}{8}$ in. above the whitewood, thus forming a rebate, into which a $\frac{3}{8}$-in. dust-board is afterwards screwed. Fig. 31 shows the position of the groove that is cut at each end of the cornice back, to fit the tongues on each side, as indicated in Fig. 31. Make all the shelves of whitewood to finish a full $\frac{7}{8}$ in. thick, facing the front edges with $\frac{3}{8}$-in. walnut. The finished width for the upper shelves is $6\frac{7}{8}$ in., and for the lower ones $10\frac{7}{8}$ in. Fig. 32 is a detail of the $2\frac{3}{4}$-in. by $\frac{1}{2}$-in. curved piece, which is tongued to

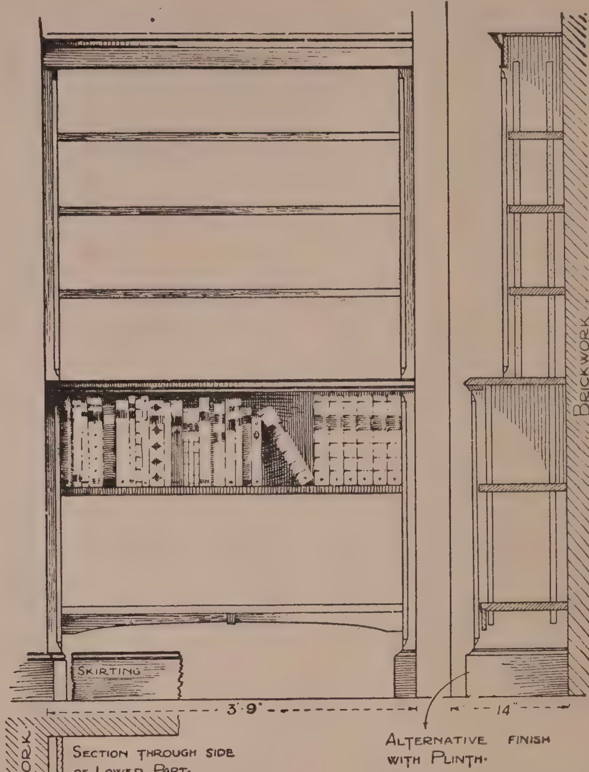


Fig. 25.

Fig. 26.

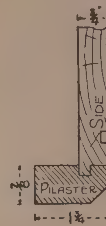


Fig. 27.—Section through Pilaster

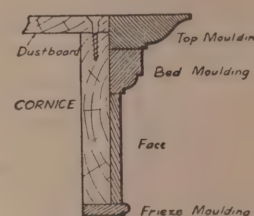


Fig. 30.—Section through Cornice and Dust-board

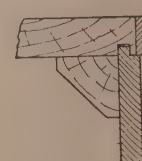
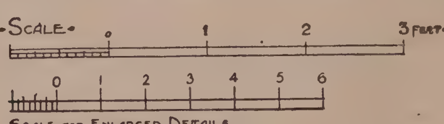


Fig. 32.—Section through Bottom Shelf

Figs 25 and 26.—Front Elevation and Section of Book-shelves for Recess



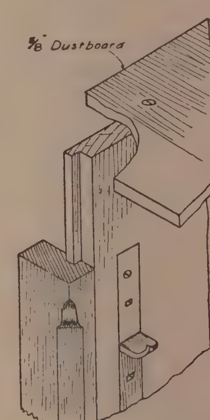


Fig. 29.—Top Corner with Cornice Removed to show Tongue

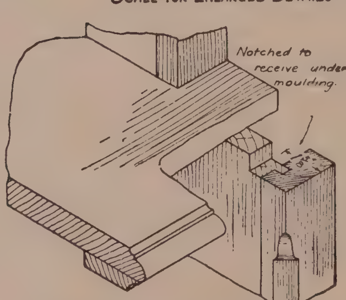


Fig. 28.—Detail of Notch for Under Moulding

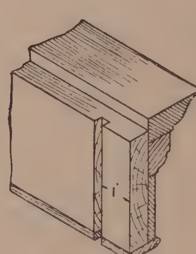


Fig. 31.—Back View of Cornice

the underside of the bottom shelf, and strengthened with blocks which may be glued at the back. The moulded shelf, a

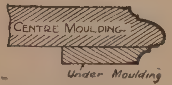


Fig. 33.—Section of Moulded Shelf

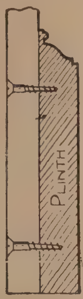


Fig. 34.—Section of Plinth

section of which is shown by Fig. 33, and which forms the division between the upper and lower portions, is, of course, a fixture; but all other shelves (including the bottom one) are adjustable. For supporting the shelves strips of metal, called ladders, are screwed into grooves shaped as shown in Fig. 27, which are ploughed in the side pieces. These ladders are pierced with small holes at regular distances of about 1 in., and small metal supports are inserted for the shelves to rest upon, as illustrated in Fig. 29.

If the room has a skirting board, the pilasters should be scribed over it, and a finish obtained by working, moulding, and mitreing a length of skirting along the sides. Should there be no skirting board, a neater finish can be made by mitreing and screwing (from the back) a 6-in. plinth of walnut, details of which are shown by Fig. 34. The appearance of the pilasters is improved by working a $\frac{1}{2}$-in. stop-chamfer on the edges, and when this is accomplished the whole will be ready for finishing prior to finally setting up the parts in position. After staining the whitewood to match the walnut, finish the whole with either french or wax-polish, according to choice.

Proceed to set up in position as follows: First place the lower sides against the walls, and screw down the wide moulded shelf to them. The screw-heads will be covered by placing the upper sides into position, after which fit the cornice on to the tongues, and screw the $7\frac{1}{4}$-in. by $\frac{3}{8}$-in. dust-board into the cornice rebate and also into the top of the upper sides. Finally insert the metal supports into the ladders, and place the shelves as required. If the work has been carried out as described there should be no need to screw the sides to the walls. The position and number of shelves is a matter of choice, for any shelf not in use can be placed on the top of the dust-board. The fitment can be quickly taken to pieces for removal in the following order: (1) Remove all shelves and metal supports; (2) unscrew and remove the dust-board and the cornice; (3) remove the upper sides; (4) unscrew and remove the moulded shelf and, lastly, the lower sides.

MOVABLE SHELVES FOR BOOKCASES

In making bookshelves or cases it is always an advantage to have the shelves adjustable to any size of books. There are various methods of doing this.

Figs. 35 to 38 show a very simple way. This is done by boring two rows of small holes (about $\frac{3}{8}$ in.) up the inner sides of the case ends, about $1\frac{1}{2}$ in. from the front and back edges, to take iron pins (*see* Figs. 37 and 38). Instead of the iron pins, fillets of wood 1 in. wide by $\frac{1}{2}$ in. thick, with two wood dowels, are sometimes used (*see* Fig. 39). It is seldom necessary to have

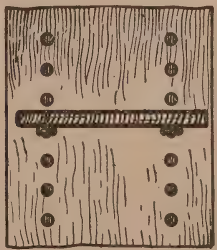


Fig. 35.

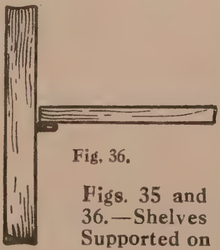


Fig. 36.

Figs. 35 and 36.—Shelves Supported on Iron Pins

a shelf nearer than 7 in. from the top and bottom. This system is easily carried out, but is only advisable when the case ends are of hardwood and suitable thickness.

Another method is shown by Figs. 40 and 41. For this, four slips of wood are prepared the length of the inside ends, by $1\frac{1}{4}$ in. wide and $\frac{1}{2}$ in. thick. They are placed together evenly and square, to be temporarily nailed for marking and cutting all of the steps at the same time. Mark square across the four edges at $1\frac{1}{4}$ in. apart, leaving 7 in. plain at each end. Run a $\frac{3}{8}$-in. gauge line on both sides from the compasses set to $1\frac{1}{4}$ in., mark along the gauge line. At these points bore holes with a $\frac{7}{8}$-in. clean-cutting centre-bit (*see* Fig. 43), then divide at the gauge line. In fixing the slips in open bookcases, the front ones should be rounded as shown in Fig. 44; or if left square, the case ends should have a bead run on to break the joint (*see* Fig. 45).

Figs. 46, 47 and 48 show different

Fig. 37.

Fig. 38.

Figs. 37 and 38. —Side and Plan Views of Iron Supporting Pins

Fig. 39.—Wood Shelf Support

Fig. 44.

Fig. 45.

Figs. 44 and 45.—Two Sections of Beadings

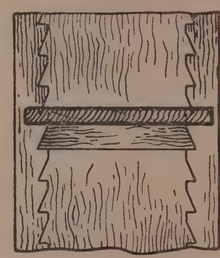


Fig. 40.—Rack Support for Shelf

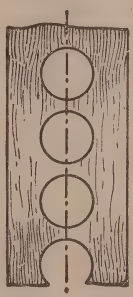


Fig. 43.—Method of Cutting Rack

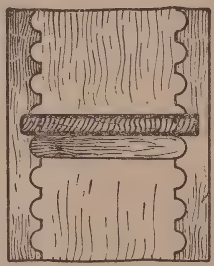


Fig. 42.—Alternative Form of Rack Support

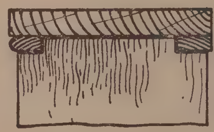


Fig. 41.—Plan View of Rack Support

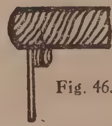


Fig. 46.

Fig. 47.

Fig. 48.

Figs. 46, 47 and 48.—Method of Fixing Leather Edging to Shelves

marked edges, cut the marks with a fine saw to the gauge lines, and with a sharp chisel make the steps. In fixing to the case sides, one of the shelf supports should be used to get the slips the correct distance apart. Fig. 42 shows a more expeditious way of making the slips. Two lengths must be got out $2\frac{1}{2}$ in. wide by $\frac{1}{2}$ in. thick, placed evenly together, and temporarily nailed. A gauge line is run along each side exactly central; then with a pair of

methods of fixing the leather edging to shelves. In Fig. 46 are shown slips of wood $\frac{1}{2}$ in. square in section, which are nailed on the underside, about $\frac{1}{8}$ in. from the corner of the rounded edge, the leather edging being fixed with glue. Fig. 47 shows the upper edge of the leather held between the shelf and the slip, which is screwed on, no glue being required. Fig. 48 shows the shelves grooved, the edging being wedged in with the slip.

Dwarf Bookcases

DWARF BOOKCASE WITH GLAZED DOORS

THE bookcase as shown in the half-tone reproduction (Fig. 1) is of a quiet design that is not likely to clash with furniture of any period, and in the details and instructions which follow the whole of the work has been made extremely simple. Front and side elevations and plan are shown by Figs. 2, 3 and 4.

The making of the doors presents the only difficulty, and these are open to modification if required. For instance, the diamond arrangement of the glazing bars could be altered to a series of rectangular panes of quite pleasing proportions, by means of one vertical and two horizontal bars to each of the two doors; or, of course, all the bars could be omitted. This would, however, deprive the bookcase of most of its interest as a design, and it is suggested as an alternative that the glazing might be of leaded glass, either in some fairly ordinary decorative manner, or perhaps divided with very broad lead cames into such a simple design as that shown on the right-hand side of Fig. 2.

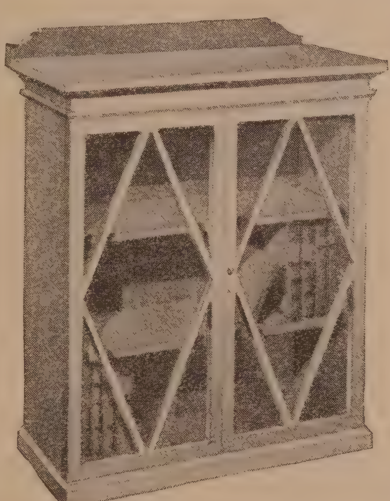


Fig. 1.—Dwarf Bookcase with Glazed Doors

It is not desired to advocate "short-cut" methods in joinery or cabinet-making; but as it is felt that an inexperienced amateur might hesitate to tackle a piece of work requiring such careful and comparatively minute work as the tenoning together of the doors for this bookcase, the following suggestion may show him a way of circumventing the obstacle. It is simply to mitre the four sides of the doors together, as might be done with a picture-frame; securely done, this does not make a bad job; but, of course, it is far inferior to the traditional method of framing up.

Any material can be used, although, naturally, a hardwood is desirable for any furniture of this class, and the main parts of the construction are given in Fig. 5. Here are seen two upright sides A and B, $9\frac{1}{2}$ in. by 1 in. and 2 ft. $10\frac{1}{2}$ in. long, having a $\frac{1}{2}$-in. by $\frac{1}{2}$-in. rebate down their inner back edges as at C. Two and a quarter inches up from the bottom each upright has a groove $\frac{3}{8}$ in. deep and $\frac{1}{2}$ in.

high to receive the tongued end of a bottom shelf 9 in. by 1 in. and 2 ft. 1¾ in. long, as at D (Fig. 6), this joint being afterwards strengthened by means of angle-

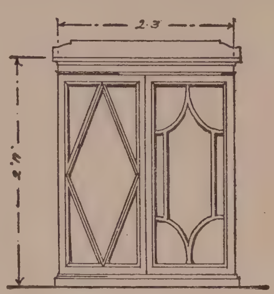


Fig. 2.

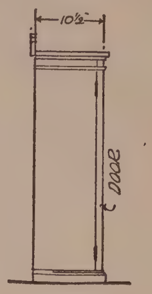


Fig. 3.

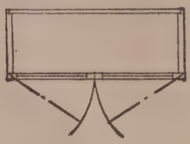


Fig. 4.

Figs. 2, 3 and 4.—Front and Side Elevations and Plan of Dwarf Bookcase with Glazed Doors

blocks underneath as there shown. Note that the front edge of this piece comes out to the same face as the front edges of the sides, and therefore its back edge should correspond with the front edge of the rebate C. The top shelf, 2 ft. 4¾ in. long and 11⅜ in. by 1 in., has its back edge coinciding with that of each side; but the lower part of this edge is rebated ½ in. by ⅜ in. to receive the back, as in Fig. 7 at G. At a later stage all its sharp angles should be rounded off. At present, however, to obtain a good durable job, the top of each piece should be rebated, so as to leave a tongue ½ in. by ⅜ in. high, which should be let into a groove in the underside of the top, as at E (Fig. 6). This will complete the main structure of the bookcase, and the smaller parts can next be dealt with.

First of all, a light back might be fixed into the rebates in the top and sides, and butted against the back edge of the bottom shelf, as shown at F (Fig. 7). This back might be of ½-in. stuff, tongued together if possible, and if well fixed it will add a good deal of rigidity to the work as a whole. The back of the top will ultimately be finished with an upright piece 3½ in. by ½ in. or so and 2 ft. 4¾ in. long, applied as at G (Fig. 7), and shaped at each end to some such contour as the ogee curve indicated at the top of Fig. 6, this piece being, of course, to help fill in the gap next the wall usually caused by the thickness of the skirting board. Any intermediate shelves required across the interior should be about 9 in. by ¾ in., with their ends not fixed, but merely resting on small fillets fixed against the sides, as at H (Fig. 6).

For the front of the bookcase, pieces 2¼ in. by 1 in. and 2 in. by 1 in., as at J and K in Fig. 7, and both 2 ft. 3 in. long, should be fitted against the front faces of the side pieces at the top and bottom, as suggested by the dotted lines at L (Fig. 5). The joint at the top should be carefully secured to avoid its opening subsequently, and it might be fixed by means of small triangular blocks on the inside where out of sight. The top is intended to be finished with a small ovolo moulding under the edge of the projecting shelf, and a very small bead, approximately a quadrant in section, planted on just above the bottom edge of the piece J (Fig. 7). The base is

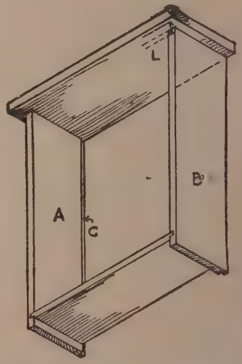


Fig. 5.—Detail of Carcase of Bookcase

finished with a 1¾-in. by ½-in. skirting slightly moulded, and mitred round as shown just a shade above the floor-level.

The doors should be fitted as tightly as

possible in order to exclude dust, and are 1 in. thick, hinged as shown on plan in Fig. 8, which also indicates a small fillet M fixed along the edge of the left-hand door for the other leaf to butt against. A similar fillet will be advisable, as at N (Fig. 7), fixed along the bottom edge of the piece J, and presenting a width of about $\frac{3}{8}$ in. to stop the doors. The latter, subject to the remarks previously made, should be possible. For the diamond treatment they should be set out with the points Q and R (Fig. 9), each in a line with the inner edges of the frame. The bars will need very carefully fitting as shown, and it will be best to arrange their ends with neat little projecting tenons let into the frame, as dotted at S and T, and bradded in addition. Without these tenons there is a risk of the bars working loose in time.

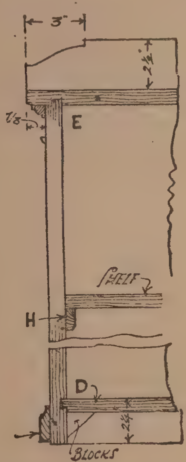


Fig. 6.—Part Front Sectional Elevation

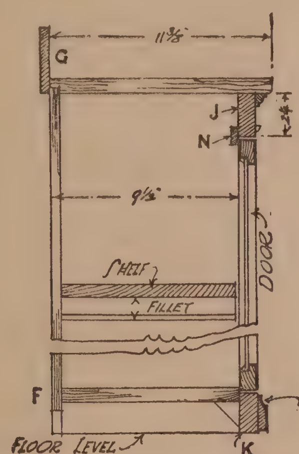


Fig. 7.—Side Sectional Elevation

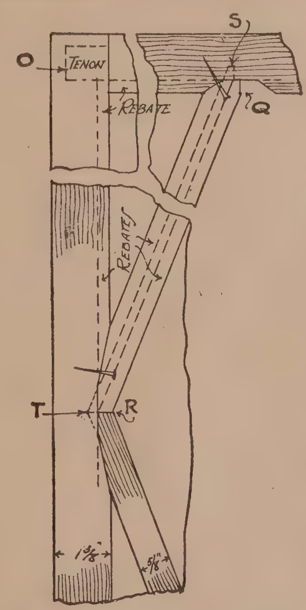


Fig. 9.—Detail of Construction of Door

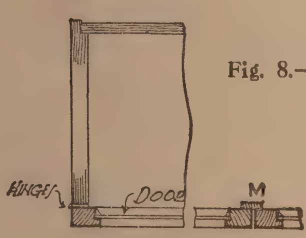


Fig. 8.—Part Plan Detail at End

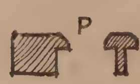


Fig. 10.—Detail of Door

framed up with 1-in. by $1\frac{3}{8}$-in. stuff tenoned at the angles, as at O (Fig. 9), and rebated at the back to receive the glazing. If desired, they can be moulded along the front, but it is suggested that any moulding be dispensed with in favour of a square edge slightly rounded off, as at P (Fig. 10). This would also apply to the wooden glazing bars, if these are adopted, in which case they should be kept as light as possible. If a moulded section is preferred, it must be mitred with great care at the intersections, and when the glass is ready to be inserted in the panes, it may be simpler to use putty than fixing-beads.

SMALL BOOKCASE WITH RACK

A bookcase of rather more elaborate design and yet of simple construction is

shown by Fig. 11. The illustrations, Figs. 12 to 16, show two elevations, two sections, and plan of the case.

The work could be carried out in any desired wood, and might be elaborated with inlay by the expert cabinet-maker. If preferred, the glazed doors could be omitted. If used, the doors can be rendered decorative by either of the arrangements of glazing bars shown in Fig. 12.

The sides of the main case should finish about 3 ft. $2\frac{5}{8}$ in. by $7\frac{7}{8}$ in. and 1 in. thick. At a height of $2\frac{1}{2}$ in. above the floor they are connected by a $\frac{7}{8}$-in. bottom shelf $8\frac{5}{8}$ in. wide, as at A (Fig. 17), 2 ft. $1\frac{3}{4}$ in. long, and stop-housed into the uprights, leaving $\frac{3}{8}$ in. for a back as at B. Later, the bottom will be finished with stout longitudinal bearers, as at C and D, secured with screws and angle-blocks, and a $2\frac{3}{4}$-in. by $\frac{5}{8}$-in. moulded skirting mitred round the ends and front as shown. The sides are stop-housed $\frac{3}{8}$ in. deep into a top shelf E (Fig. 17) 2 ft. $3\frac{1}{2}$ in. by $9\frac{3}{4}$ in., slightly rounded on the exposed edges, overhanging $\frac{1}{4}$ in. on the ends and the front, but $\frac{1}{2}$ in. at the back, where it is slightly rebated to receive the $\frac{3}{8}$-in. back filling, which is fixed horizontally in $\frac{3}{8}$-in. by $\frac{3}{8}$-in. rebates in the sides, as at F in Fig. 16.

The doors are $1\frac{1}{8}$ in. thick, or less if hard wood be employed, ovolo moulded and tenoned together in the usual manner, the glass being secured on the inside with small wood fillets. Hinges should be arranged for the doors, as in Fig. 13, and a fillet at the top and rebate at the bottom G and H (Fig. 17) to exclude dust, for which purpose small fillets might also be fixed on the insides of the doors, as at J in Fig. 15, to form a fairly tight joint when closed, these fillets being fixed from the back before it is filled in. The same figure shows a strip at the meeting of the two doors; it should be fixed on the left-hand one to form a rebate. The upper part of the work consists of two $\frac{7}{8}$-in. uprights, $11\frac{3}{4}$ in. long and 6 in. wide, dowelled to the main top shelf, and housed into a smaller shelf K $1\frac{1}{8}$ in. thick, and moulded on the solid, as shown in Fig. 17. The whole should be rebated for a back L similar to that below, but overhanging it to the extent of $\frac{1}{2}$ in. At the front is fixed a rail M $1\frac{1}{2}$ in. by $\frac{5}{8}$ in., finishing with a thin bead on the underside. A part longitudinal section is given by Fig. 18, and this renders the reading of Fig. 17 easier.

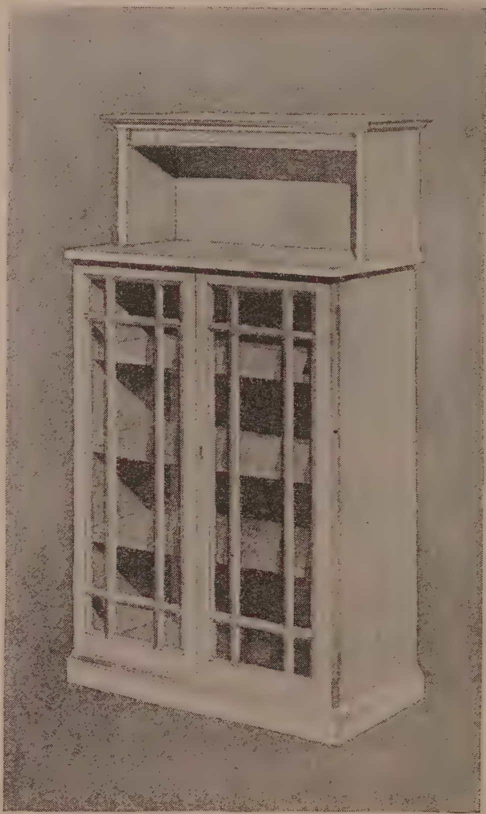


Fig. 11.—Small Bookcase with Rack

DWARF INLAID BOOKCASE

The dwarf bookcase shown by Fig. 19 is intended to be made in mahogany, and inlaid with boxwood lines and circular corners on the two doors.

The shelves are movable, and can be adjusted to any height (*see* Fig. 20). A

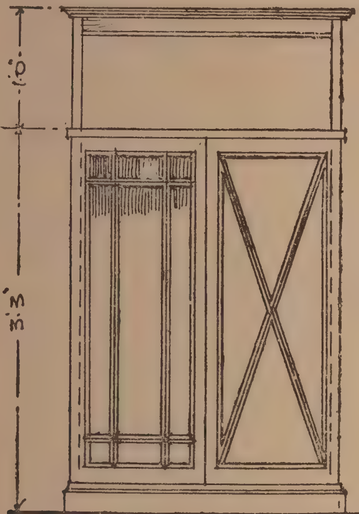


Fig. 12.

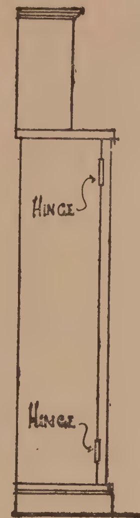


Fig. 13.

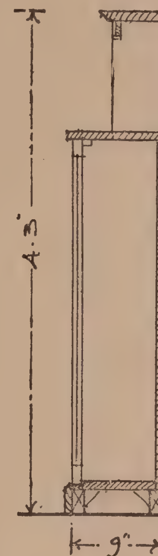


Fig. 14.

Figs. 12, 13, 14, 15 and 16.—Front and Side Elevations, Vertical and Cross Sections and Plan of Bookcase with Rack

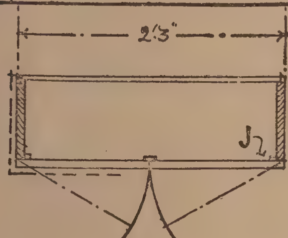


Fig 15.

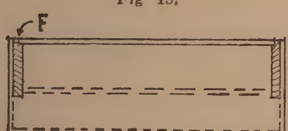


Fig. 16.

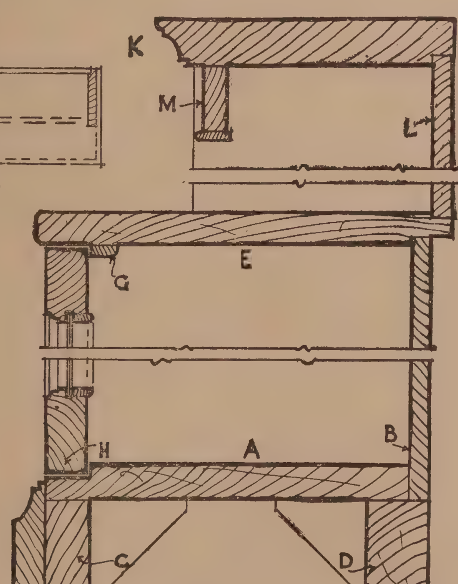


Fig. 17.

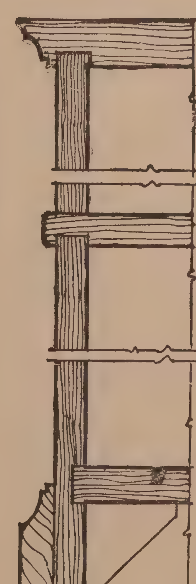


Fig. 18.

Figs. 17 and 18.—Enlarged Detailed Sections of Bookcase

Scale: Figs. 17 and 18, 3 in. = 1 ft.

middle gable divides the carcase in two, making the shelves stiffer, and giving a more compact arrangement for the books. The length of the bookcase over the doors is 3 ft. 3 in.; height from floor to top, 3 ft.; depth over gables, including doors, 11 in., which gives an inside depth of $9\frac{1}{2}$ in., allowing $\frac{1}{2}$ in. for the back and 1 in. for the doors. The splayed plinth gives character to the bookcase, and is easily made. Fig. 21 shows the method of making it up. A pine frame 4 in. deep by $\frac{3}{4}$ in. thick is dovetailed together, bevelling the front and ends about $\frac{1}{2}$ in. from the perpendicular. Clamps of oak, $\frac{1}{4}$ in. thick, are glued on the front and ends, mitreing them at the corners, afterwards cutting the front to the shape shown in Fig. 19. Mitre the moulding (Fig. 22) $2\frac{1}{2}$ in. wide by $\frac{5}{8}$ in. thick to the top edges of the plinth at the front and ends, and put a few blocks inside to strengthen it. Plane up the two outside gables, 10 in. wide by $\frac{7}{8}$ in. thick, and lap-dovetail them to receive the top and bottom, which are $\frac{5}{8}$ in. thick (*see* Fig. 23). Rebate the back edges of the gables $\frac{1}{2}$ in. deep for the back. The middle gable is $9\frac{1}{2}$ in. wide by $\frac{7}{8}$ in. thick, and is fixed to the top and bottom with square pins mortised through and wedged.

Before gluing the carcase together, the holes should be bored in the end and middle gables for the brass studs which support the movable shelves. Bore them at intervals of 1 in. between the centres. The studs (Fig. 24) are sunk flush with the underside of the shelves to prevent the latter shifting. The edge of the shelf is finished with a moulding. In boring the holes in the middle gable, alter the distance from the edges sufficient to allow the studs to clear each other on the opposite sides. The carcase back shown in the plan (Fig 23) is $\frac{1}{2}$ in. thick, and consists of three muntins grooved to receive the tongues on the panels. Work a small bead on the edges of the panels

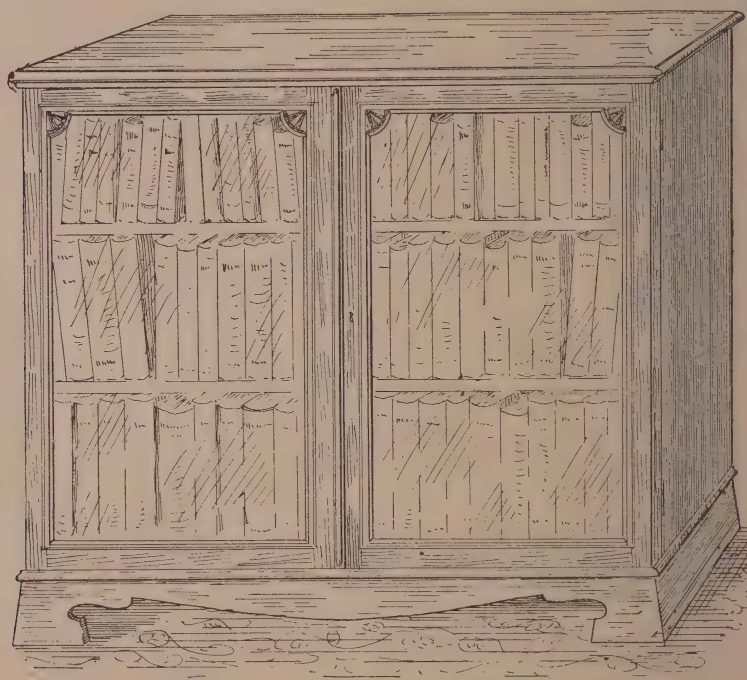


Fig. 19.—Dwarf Inlaid Bookcase

to break with the flush joint. The middle muntins should be 5 in. wide and the two end ones 3 in. wide. The top is $\frac{3}{4}$ in. thick, the finished size over the moulding being 3 ft. $4\frac{1}{2}$ in. long by 1 ft. 1 in. wide. It projects $\frac{3}{4}$ in. over the ends and front and $1\frac{1}{4}$ in. over the back. A moulded clamp (Fig. 25) is mitred and glued to the underside of the top. Screws only should be used to fix the ends, so as to allow the top freedom to shrink. The stiles and rails of the two doors (*see* Fig. 26) are $1\frac{1}{2}$ in. wide by 1 in. thick, except the right-hand stile of the left-hand door, which is kept about $\frac{1}{4}$ in. wider to underlap the dividing bead. They are mortised and tenoned together, and a small ovolo moulding is worked on the inner edges. Rebate the edges to receive the glass. Work the rebates the same distance on the edges as the moulding, so as to form a square shoulder for the mortise-and-tenon joints (*see* Fig. 27). The boxwood lines on the doors, as in Fig. 27, are inlaid in the following manner: File a piece of broken saw-blade to the width of the line, and insert it in an easily made router (Fig. 28). Work

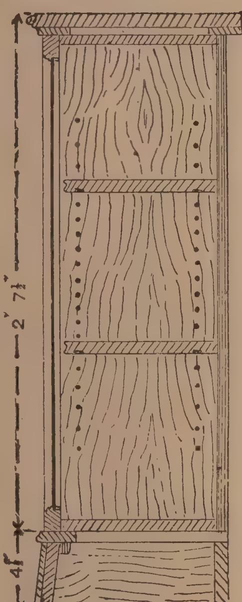


Fig. 20.—Vertical Section of Dwarf Inlaid Bookcase

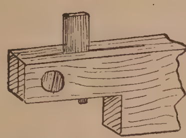


Fig. 28.—Router for Inlays

Fig. 26.—Section of Doors

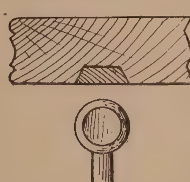


Fig. 24.—Method of Fixing Shelves

Fig. 29.—Dividing Bead on Doors

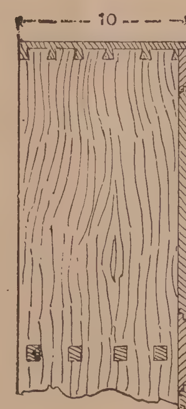


Fig. 23.—Part Plan of Carcase of Bookcase

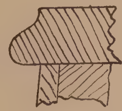


Fig. 22.—Moulding of Plinth

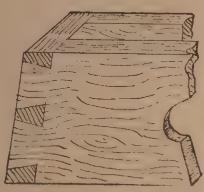


Fig. 21.—Detail of Plinth

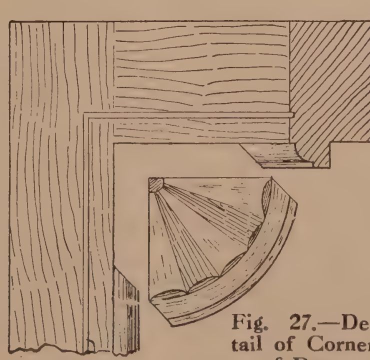


Fig. 27.—Detail of Corner of Door

Fig. 25.—Moulding of Top

the router with a forward motion till the required depth is obtained. Then glue in the lines and mitre them at the corners.

The circular corners shown in Fig. 27 are first turned with the same moulding on the edges as the doors, and the inlay made up of angular strips of boxwood and mahogany veneers. After gluing the corners in position, a piece of cotton glued to the back will strengthen the joint.

The closing bead (Fig. 29) is glued to the edge of the stile on the right-hand door (*see* Fig. 26). It need not be rebated until fixed on the door. Fig. 29 shows the finish of the bead at the ends. Use $2\frac{1}{2}$-in. brass butt hinges for the doors. A flush bolt for the left-hand door and a lock for the other door complete the fittings. The glass panels should be thinly bedded in with putty coloured to match the mahogany, and fixed with beads mitred and bradded to the rebated edges of the doors.

All the internal parts of the bookcase (shelves, top and bottom, back and middle gable) may be of pine with slips of mahogany glued to the front edges. In

Fig. 30.—Dwarf Bookcase with Shelf

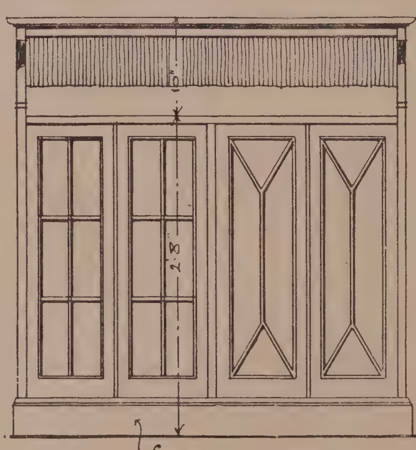


Fig. 31.

Fig. 32.

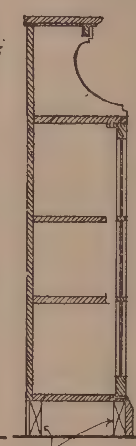


Fig. 33.

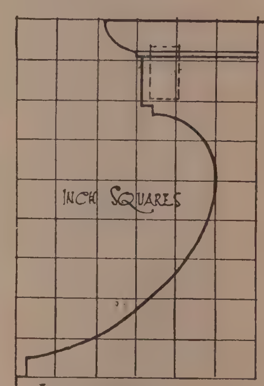


Fig. 36.—Detail of Shaped Ends

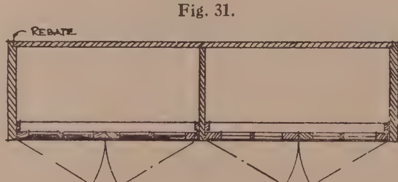


Fig. 34.

Figs. 31, 32, 33 and 34. —Front and Side Elevations and Vertical and Cross Sections of Dwarf Bookcase

Scale : $\frac{5}{8}$ in. = 1 ft.

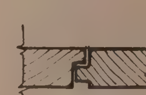


Fig. 35.—Cross Section of Meeting Stile

Fig. 37.—Curtained Bookcase with Central Glazed Cupboard

polishing the bookcase care should be taken to keep the inlays as clear as possible.

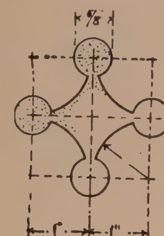


Fig. 43.—Detail of Pierced Ornament

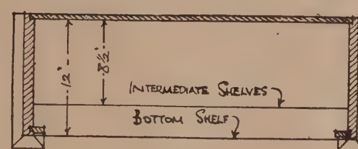


Fig. 42.

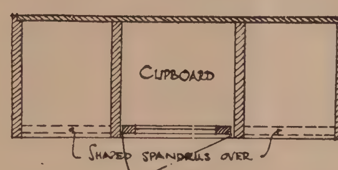


Fig. 41.

Figs. 38 and 39.—Front and Side Elevations
Fig. 40.—Vertical Section
Figs. 41 and 42.—Cross Sections

Scale : $\frac{5}{8}$ in. = 1 ft.

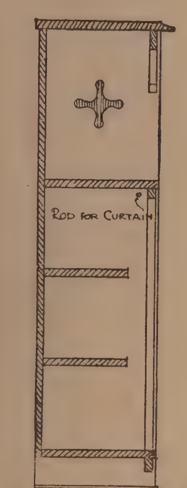


Fig. 40.

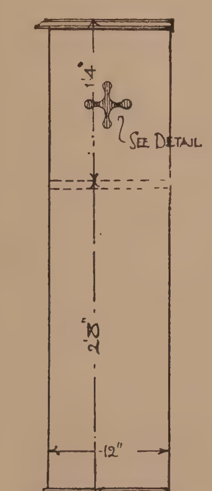


Fig. 39.

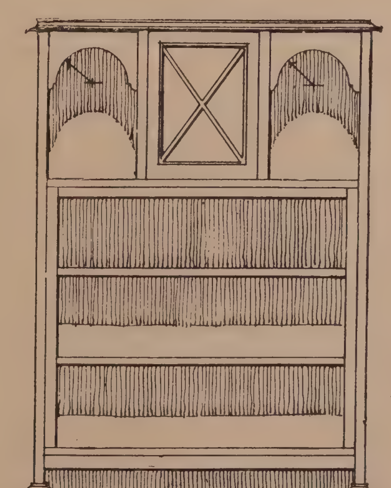


Fig. 38.

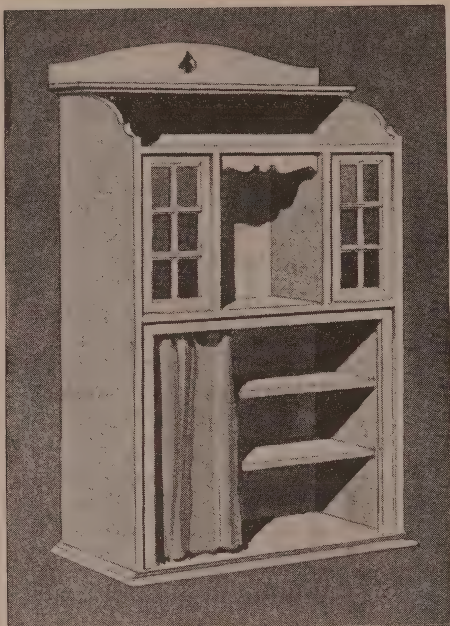


Fig. 44.—Curtained Bookcase with Two Glazed Cupboards

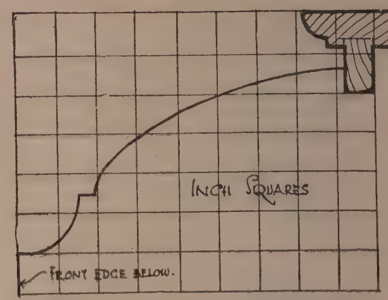


Fig. 49.—Detail of Shaped Ends

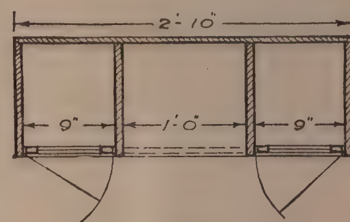


Fig. 48.

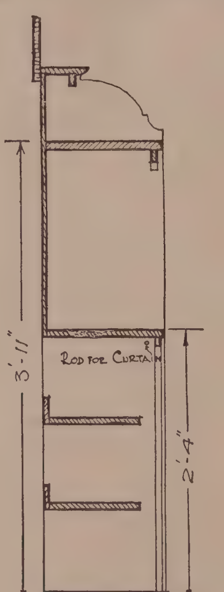


Fig. 47.

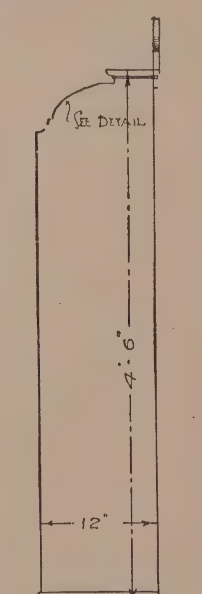


Fig. 46.

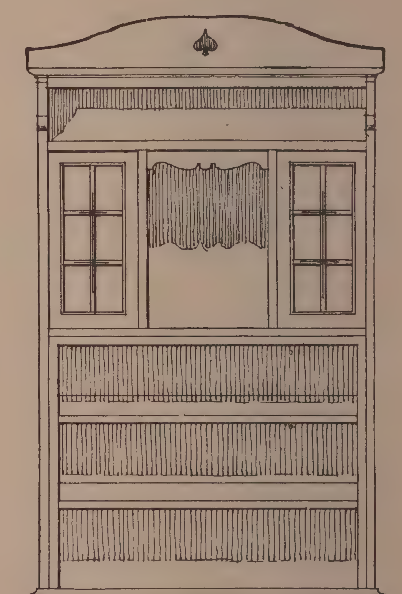


Fig. 45.

Figs. 45, 46, 47 and 48.—Front and Side Elevations and Vertical and Cross Sections
Scale : $\frac{5}{8}$ in. = 1 ft.

DWARF BOOKCASE WITH SHELF

Constructional details of the remaining examples of bookcases in this section follow so much upon the same lines as those already described that it has not been thought necessary to treat of them fully. The design and working scale drawings given in each case, together with a few notes on the outstanding features, will be quite a sufficient guide for their construction.

The bookcase shown by the reproduced photograph (Fig. 30), and in front and side elevations and vertical and cross sections by Figs. 31 to 34 respectively, has two pairs of doors with wood glazing bars arranged

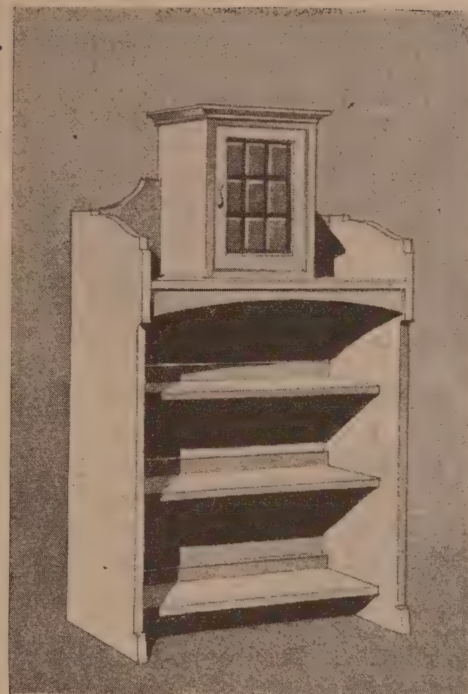


Fig. 50.—Open Bookcase with Central Glazed Cupboard

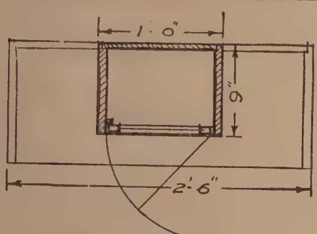


Fig. 54.

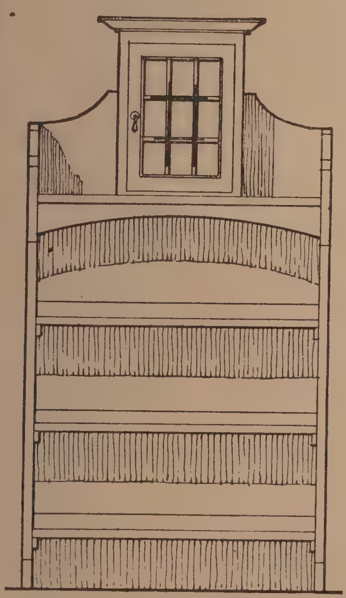


Fig. 51.

Fig 52.

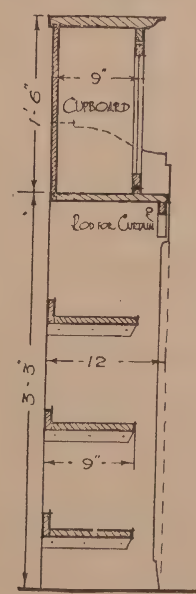


Fig. 53.

Figs. 51, 52, 53 and 54.—Front and Side Elevations and Vertical and Cross Sections
Scale : $\frac{5}{8}$ in. = 1 ft.

in plain rectangles, or in accordance with some simple geometric pattern, as on the right of Fig 31. These narrow doors are much more convenient for access than wider ones, and the meeting-stiles can be sunk and rebated as in Fig. 35. The shelves should be adjustable, preferably with metal strips and pins let in at the upright ends of the case, or otherwise in accordance with one of the other methods given on an earlier page. The method of producing the curved tops of the side pieces is shown by Fig. 36.

CURTAINED BOOKCASES WITH GLAZED CUPBOARDS

The design in Fig. 37 is rather less akin to the conventional bookcase, having a small cupboard flanked by open recesses at the top, and some shelves screened by a curtain sliding on a small rod below. Figs. 38 to 42 show front and side elevations, vertical section and two cross sections. An alternative to the draped curtain would be a spring-roller and blind to draw down from the top of the lower portion. The diagonal bars to the cupboard door are in wood. A detail of the side ornaments is shown by Fig. 43.

Similar in general idea to the last example, Fig. 44 has two open shelves at the top, two glazed cupboards and a central recess below them, and at the bottom a series of curtained shelves. Particular attention should be paid in this—as also in the other designs—to the mouldings, pierced ornaments and shaped portions. As with the two preceding cases, the illustrations (Figs. 45 to 49) are deemed sufficiently explanatory.

OPEN BOOKCASE WITH CENTRAL GLAZED CUPBOARD

Another bookcase on similar modern lines to the three last described, but varied somewhat in detail and arrangement, is shown by Fig. 50. Front and side elevations and a vertical section and plan are shown by Figs. 51 to 54. The small panes to the cupboard should be in leaded glazing. If wood bars are used, four panes only would be suitable.

Revolving Bookcases

MINIATURE REVOLVING BOOKCASE

The small bookcase shown by the half-tone reproduction (Fig. 1) is of a very suitable size for general purposes, and the construction is such that it could easily be adapted for two tiers of books if required.

Such a bookcase of the revolving type should naturally be built to suit the volumes for which it is intended.

The design can be varied by different treatments of the four upright sides, which are shown relieved by a simple line of inlay. This might be made more elaborate, or a moulding substituted to give a panelled effect, or the sides could be shaped or fretted if desired. A more personal interest than that resulting from the precise reproduction of someone else's design can be infused into the work by means of such modifications.

Fig. 1.—Miniature Revolving Bookcase

Its construction is as follows : A square top with moulded edges A (Fig. 2) is connected to a bottom shelf B by means of a $\frac{5}{8}$-in. upright on each side C (Figs. 3 and 4), screwed to the top by means of a fillet mitred round the underside D (Fig. 5), and notched into the bottom, screwed and finished with a mitred moulding, as at E in Fig. 5. In the centre is a square pillar F (Fig. 2), sub-tenoned at the top and having its lower end rounded $1\frac{1}{4}$ in. in diameter and projecting $1\frac{3}{4}$ in. below the bottom shelf. Fillets G in Fig. 4 should be fixed on the bottom, as guides for the books.

The base consists of a 1-in. board H (Figs. 2, 3, and 4), with shaped feet framed in along its diagonals. These feet are seen in true elevation in Fig. 3 and foreshortened in Fig. 2. Four small friction-rollers should be fitted in slots, as at I in Fig. 4, the rounded end of the central pillar

fitted loosely through a circular hole in the middle of the base, and secured with a metal or hardwood disc screwed on, as at J in Fig. 2, thus completing the bookcase.

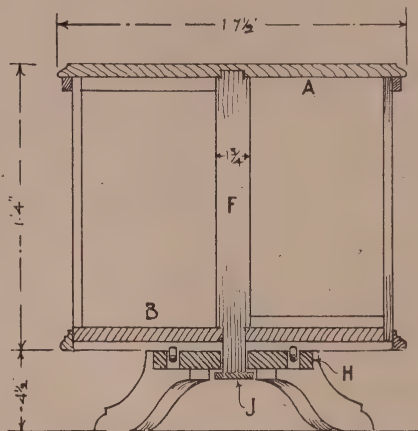


Fig. 2.

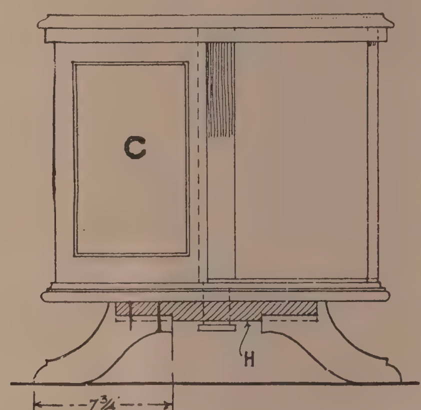


Fig. 3.

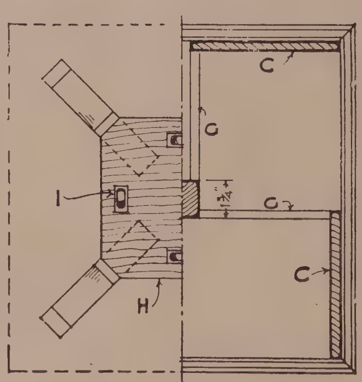


Fig. 4.

Miniature Revolving Bookcase

Fig 2.—Cross Section

Fig. 3.—Side Elevation and Section of Base

Fig. 4.—Part Plans

Fig. 5.—Enlarged Details of Side

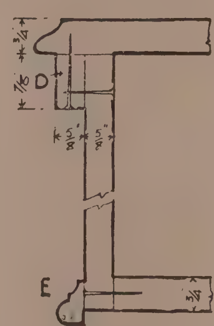


Fig. 5.

For heavy wear the bottom shelf, if not of hardwood, should have a metal track on its underside to prevent the rollers from wearing a rut into it, as might happen after a time.

A 3-FT. REVOLVING BOOKCASE

A revolving bookcase of neat design is illustrated by Fig. 6, the chief elevations and sections being presented by Figs. 7 to 10. The inner case is shown by Figs. 11, 12 and 13, while Fig. 14 is a sketch more clearly showing its construction. Fig. 15 illustrates a detail of the top at B (Fig. 8). Fig. 16 is also a section and gives details of both inner and outer cases; it corresponds with C in Fig. 9. Fig. 17 is a detail of the corner D in Fig. 10, while a section through the plinths, block and underframing, as at E (Fig. 8), is shown in Fig. 18. The remaining illustrations show respectively the steel pivot plates (Fig. 19) and one of the friction-rollers in its mount

(Fig. 20). In some revolving bookcases the actual case revolves round an iron standard mounted on cross legs, but in the design here illustrated the actual or inner case is pivoted between the fixed base and the top. Details of the pivot plates are given in Fig. 19, and the way in which these plates are mounted is shown in the section (Fig. 8); these plates are 2 in. in diameter.

As the construction embodies both an outer and inner case, the outer case remaining stationary while the inner one revolves, the design lends itself to more ornamental treatment than is otherwise possible. The corner pilasters (3 in. × ½ in.) may, for example, be sunk, inlaid, incised, carved, or decorated in other ways (*see* section in Fig. 16), and the upright slats can be moulded or their appearance otherwise improved.

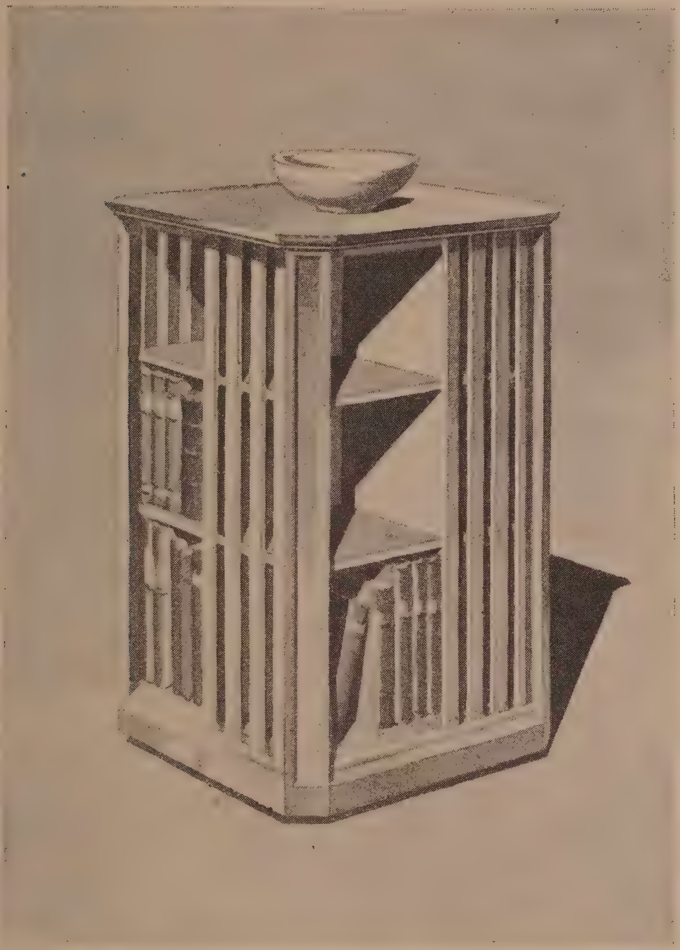


Fig. 6.—3-ft. Bookcase with Inner Revolving Part

The wiser plan when constructing the bookcase is to make the inner case first. The pivot counterparts are then attached to its top and bottom and the whole revolved on a drawing-board or on the

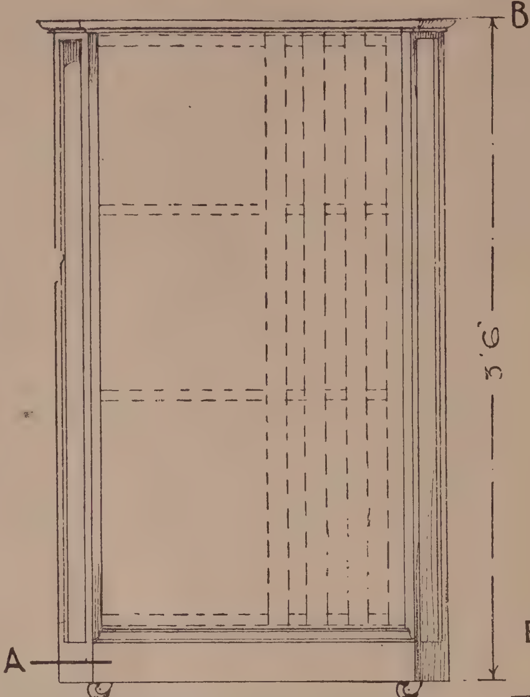


Fig. 7.—Side Elevation of Outer Case with Position of Inner Case Dotted

Fig. 8.—Section through Outer Case

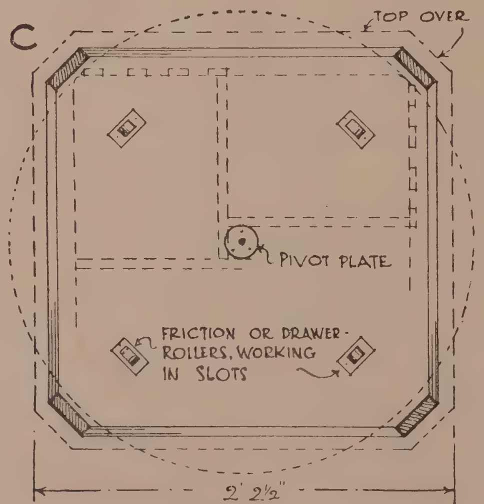


Fig. 9.—Plan of Outer Case with Part of Inner Case Dotted

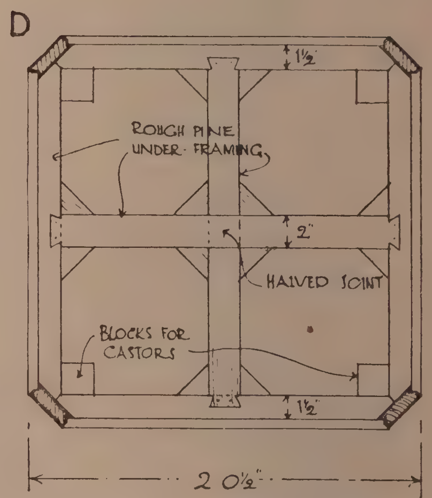


Fig. 10.—Horizontal Section on Line A (Fig. 7)

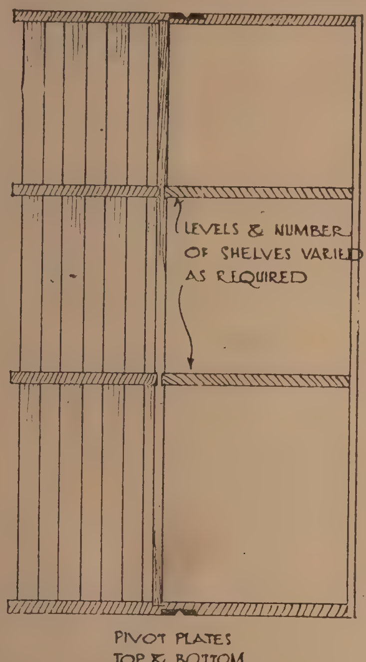


Fig. 11.—Section through Inner Case on Line X X (Fig. 13)

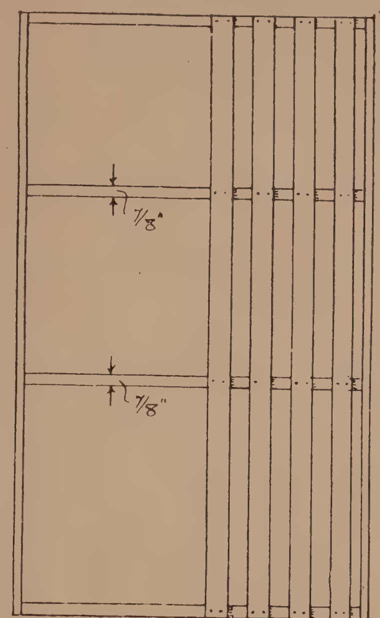


Fig. 12.—Side Elevation of Inner Case

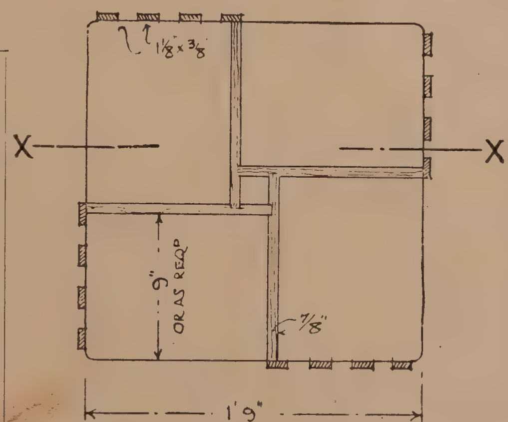


Fig. 13.—Plan of Inner Case

floor. Its path is indicated by the dotted circle in Fig. 9, and outside this circle there must be a clearance of about ½ in. Fig. 9 shows four friction-rollers or drawer-rollers mounted in slots in the upper side of the plinth; they take the weight of the inner case, and the maker can please himself as to whether he attaches to the underside of the inner case an annular iron band to travel over the friction-rollers and save wear. Special care should be taken to see that the friction-rollers are mounted as shown in Fig. 9, the axis of each one being in a line radiating from the centre; otherwise the case will not revolve freely, and there may be an unpleasant squeak when the inner case is moved.

In general, the construction of both the outer and inner cases will be obvious from the illustrations. The divisions of the inner case are housed into its base, as shown in Fig. 14. The dimensions of the various parts are indicated in the illustrations. Fig. 10 shows the strong construction of the plinth or base of the outer case, the cross-pieces being halved

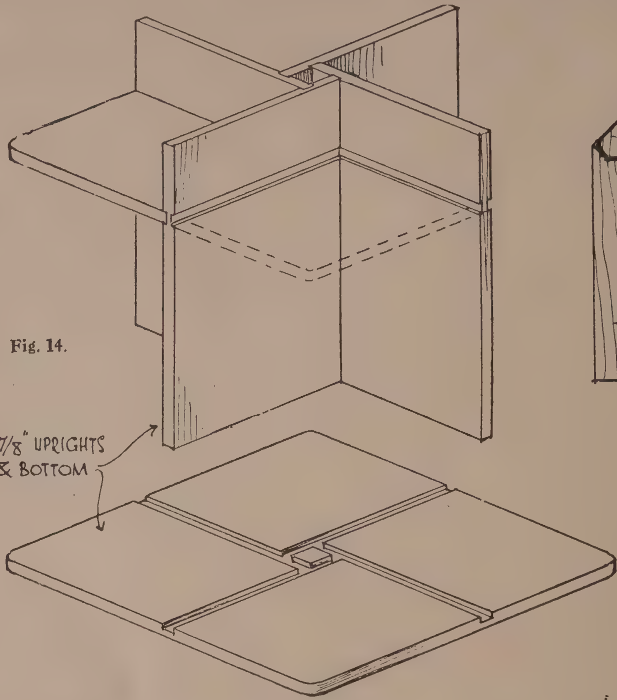


Fig. 14.

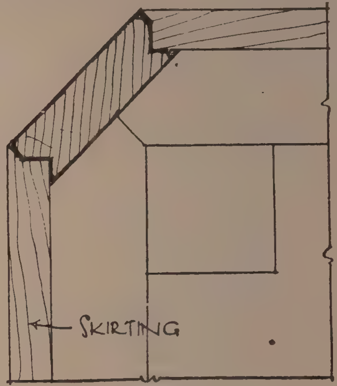


Fig. 17.

Fig. 14.—Construction of Inner Case

Fig. 15.—Detail of Top

Fig. 16.—Detail of Construction of Corners

Fig. 17.—Detail Plan at D (Fig. 10)

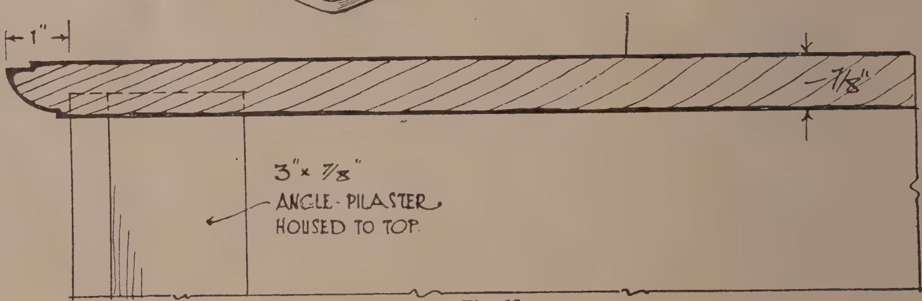


Fig. 15.

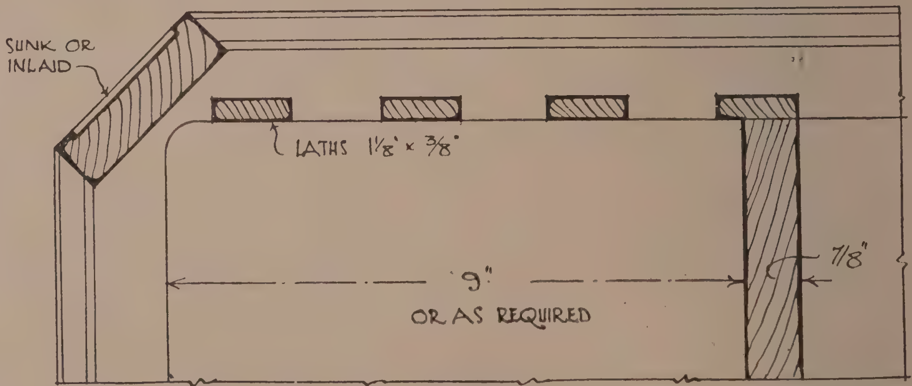


Fig. 16.

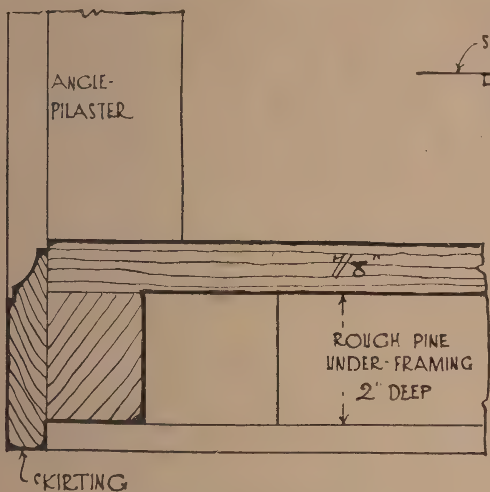


Fig. 18.—Detail of Plinth, etc.

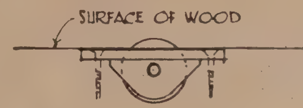


Fig. 20.—Friction Roller

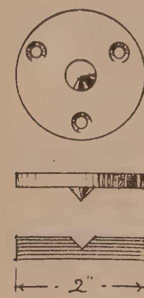
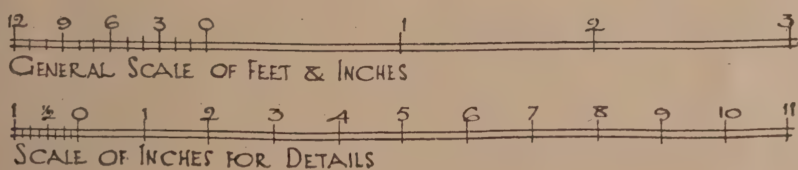


Fig. 19.—Pivot Plates



together at the centre and dovetailed into the side pieces, at which places they are further strengthened with triangular blocks. The four other corners are strengthened with square blocks, and to these are attached the castors which render the whole piece of furniture portable.

Tall Bookcases

OPEN-FRONTED BOOKCASE WITH CUPBOARD

THE open bookcase and magazine cupboard shown by Fig. 1 should not present any special difficulties to the worker with average skill, having been designed with a view to simplicity of construction and economy of labour. No elaborate mouldings or curved work have been introduced, and the finished article should be particularly acceptable in the living room. It is of oak throughout, with the door panels of the lower cupboard inlaid with rosewood, ebony and holly. It should be pointed out at the outset, however, that if this inlay is considered beyond the worker, an excellent effect could be obtained by converting the design into a stencilled pattern. The necessary elevations and a vertical section are shown in Figs. 2 to 5. The main dimensions are 5 ft. 6 in. high, 2 ft. 6 in. wide, and 12 in. deep.

Fig. 1.—Open-fronted Bookcase with Cupboard

Work should be commenced with the lower cupboard, this being built up in the usual method of carcase construction. The sides, of $\frac{3}{4}$-in. material, have a solid bottom lap-dovetailed into them, and are connected by two rails jointed to them in a similar manner at the top (*see* Fig. 6). The simple $\frac{3}{4}$-in. plinth consists of strips 3 in. wide mitred round and screwed to the bottom. The top of this lower cupboard may have its edges square with the edges slightly rounded, or a small hollow may be worked on both edges, as shown in Fig. 7. It is secured to the top rails with screws. The carcase back should, if possible, be a framed one, divided by muntins into three vertical panels. The doors are framed up plain, and are rebated to receive the panels, which, after the execution of the inlay, are beaded in from the back. The meeting-stile of the right-hand door is fitted with a plain astragal. The stand on which the

cupboard rests is simple in construction, and is screwed to the plinth. Rough thumb-slots are cut in the rails.

The upper carcase is constructed along similar lines to the lower, the two shelves being tenoned right through the sides, Fig. 8), which should be carefully cut with a sharp chisel. The upper and lower carcases are simply screwed together.

A pattern for the inlay on the doors is given by Fig. 9. This should be drawn full-size and traced on to the panels. A

Fig. 2.

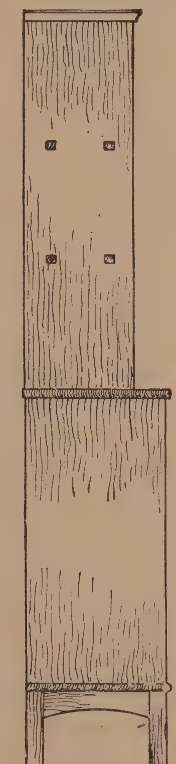


Fig. 3.

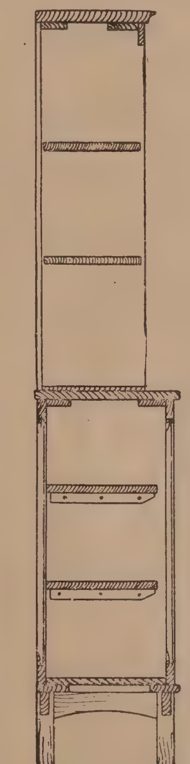


Fig. 4.

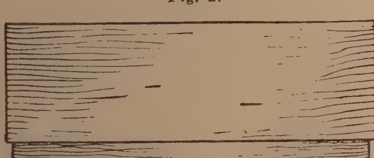


Fig. 5.

Scale

Figs. 2, 3, 4 and 5.—Front and Side Elevations and Vertical Section and Plan of Open-fronted Bookcase

and the tenons wedged diagonally. The back in this case is of matched oak boarding, screwed in at the top and bottom. The shaped rails below the cornice and plinth are simply but effectively decorated by means of a chamfered pattern (*see* separate tracing is made for each piece, which is cut out with a fret-saw, placed in position, marked round, and a recess cut for it. It should be noted that the stems, which are of ebony, should be inlaid and cleaned off first, as the leaves

(of rosewood) are partly inlaid into the stems themselves. The ribbons should be cut from holly. The interior of the magazine cupboard is a matter for individual requirements; the shelves rest on fillets screwed to the inside of the ends.

The most suitable finish for the bookcase, after thoroughly cleaning up, would be to fume it a golden brown, and wax-polish it.

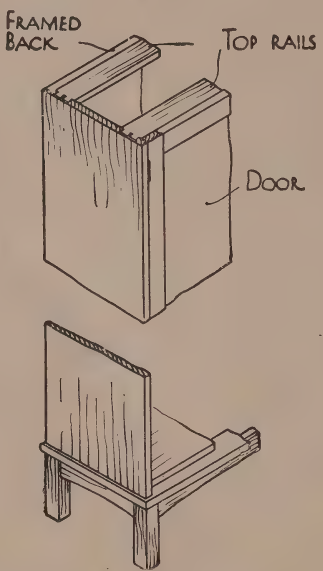
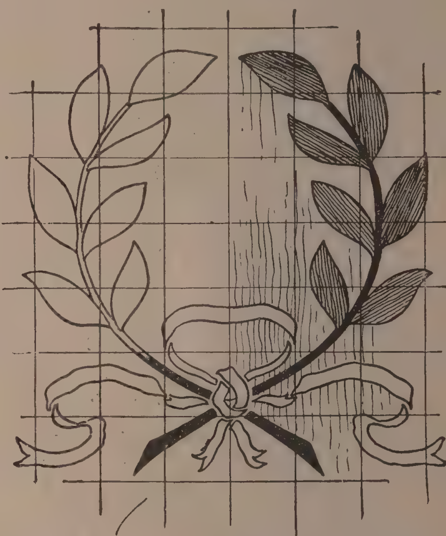


Fig. 6.



1 in. Squares Fig. 9.

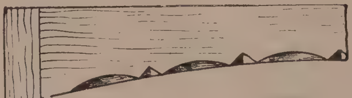


Fig. 8.

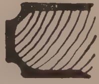


Fig. 7.

Fig. 6.—Details of Construction of Lower Cupboard
Fig. 7.—Section of Moulding for Top of Cupboard
Fig. 8.—Detail of Chamfered Pattern at A (Fig. 2)
Fig. 9.—Pattern for Inlay on Door

BOOKCASE WITH GLAZED DOORS AND CUPBOARDS

Mahogany is the wood suggested for the bookcase shown by Figs. 10 to 12. The first figure is a front elevation, the second a side elevation, and the third a vertical section. From the section it will be seen that the case is made up of two carcases. The lower part is enclosed by two doors with veneered panels, as shown in Fig. 10, and is supported by a base consisting of a pine frame mortised and tenoned together, with a moulding mitred round the edges of the front and the ends. Four tapered feet are fixed to the frame at the corners. The upper part is enclosed by two glass doors, divided by astragals in the positions indicated in Fig. 10. A loose cornice and pediment complete the upper part.

Construction should be commenced with the lower part. Plane up the two gables, and square them to 2 ft. long by

1 ft. 2 in. wide by $\frac{7}{8}$ in. thick. Rebate the back edges to receive the back, which is $\frac{5}{8}$ in. thick and tongued and grooved, as shown in Figs. 13 and 14. The top and bottom, of $\frac{5}{8}$-in. pine, are dovetailed to the gables. They should be flush at the front edges, and kept in at the back to allow the back to overlap. The back

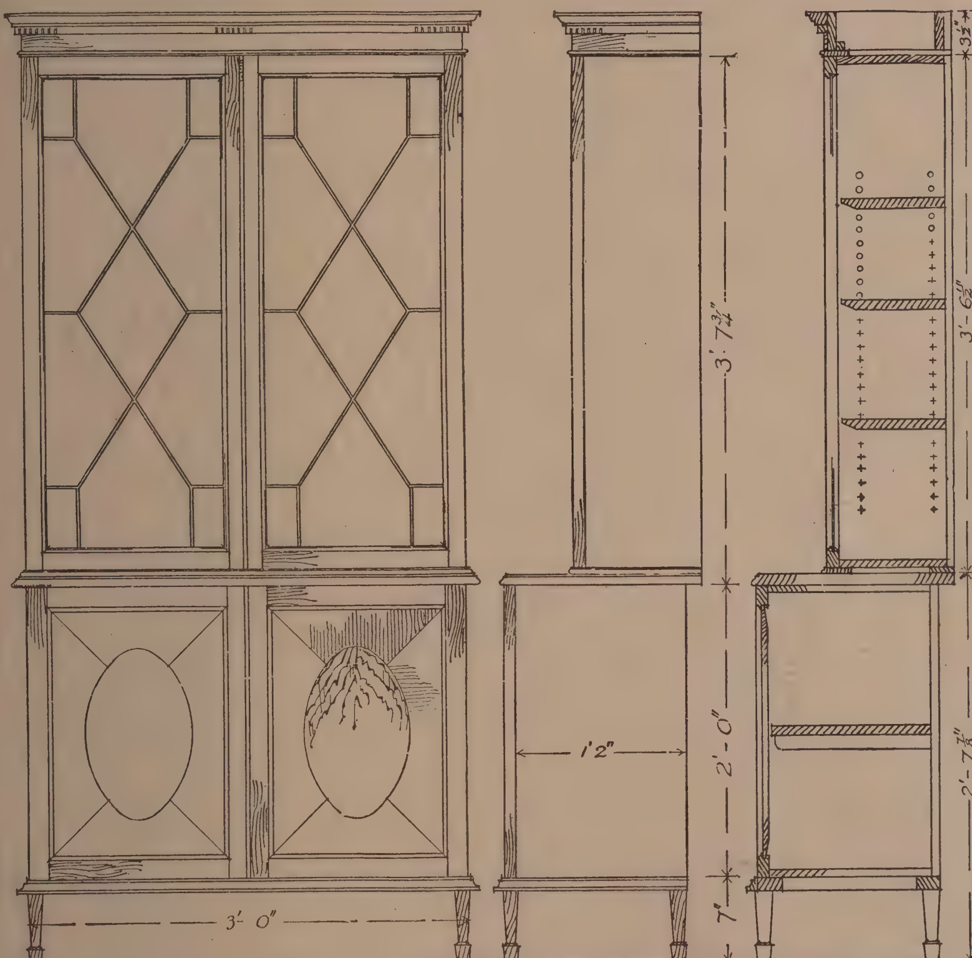


Fig. 10. Fig. 11. Fig. 12.

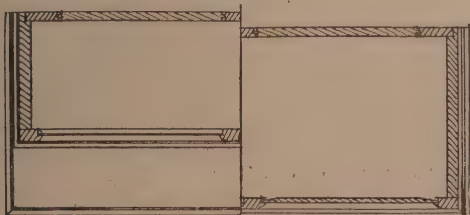


Fig. 13. Fig. 14.

Figs. 10, 11 and 12.—Front and Side Elevations and Vertical Section of Bookcase with Glazed Doors and Cupboard

Fig. 13.—Sectional Plan of Upper Part

Fig. 14.—Sectional Plan of Lower Part

consists of three muntins, 3 in. wide, and two panels which are tongued to the muntins; the joints are broken with a bead. A shelf $\frac{7}{8}$ in. thick rests on fillets screwed to the gables. The shelf may be bevelled away on the underside at the front to give it a thinner appearance. The two doors are mortised and tenoned together, the stiles and rails being 2 in. wide, except the two meeting-stiles, which should be kept $\frac{1}{4}$ in. wider for the rebates and bead A (Fig. 15). A moulding is run on inside the edges, and a rebate made for the panel, which is fixed with a bead on the inside (*see* Fig. 15).

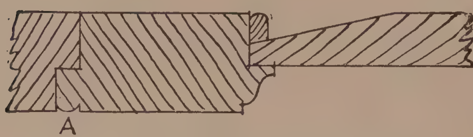


Fig. 15.—Enlarged Part Section of Lower Doors

The panels are veneered (the subject of veneering is dealt with in a later section), as shown in Fig. 10. Sound African mahogany, $\frac{1}{2}$ in. thick, should be used for a foundation for the veneer, and the surface gone over with a toothing plane before veneering. Begin by laying the piece for the oval, allowing a good margin, which can be afterwards cut off by placing a thin pine mould cut to the size over the veneer, and drawing a sharp chisel round the edge. A showy curl veneer should be used for the oval, the two diameters of which are 1 ft. 2 in. and $8\frac{1}{2}$ in. It can be rubbed down with a hammer. The veneer round the edges of the oval should be straight grained to show a contrast. It should be mitred at the corners, with the grain running in the direction shown in Fig. 10. Mortise and tenon a frame together for the base $\frac{7}{8}$ in. thick. Then mitre and glue a moulding round the edges of the front and ends.

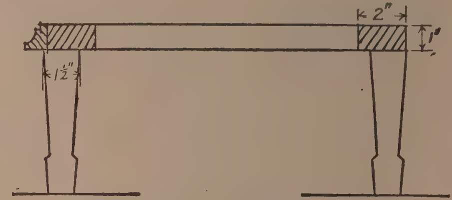


Fig. 16.—Cross Section of Base

The shaped feet (*see* Fig. 16) are screwed to the frame. The top of the lower part (Fig. 17) is $\frac{7}{8}$ in. thick, and projects over the gables at the front to cover in the doors; it also projects $1\frac{1}{4}$ in. over the back. The two gables of the upper part should be squared up to 3 ft. 6 in. long by $9\frac{1}{2}$ in. wide by $\frac{7}{8}$ in. thick, and rebated on the back edges for the back, similar to the lower gables. The top and bottom are dovetailed to the gables as already described for the lower carcase. The three movable shelves are $\frac{7}{8}$ in. thick, are bevelled on the underside, and a moulding is run on the edge (*see* Fig. 18). Bore holes on the inside of the gables 1 in. apart for the brass studs (Fig. 19), which support the shelves. Sink the studs into the shelves at B (Fig. 18). The stiles and rails of the astragal doors (*see* Fig. 10) are $1\frac{3}{4}$ in. wide by 1 in. thick. Frame up the doors before fixing in the astragals, which are made up in two pieces, C and D (Fig. 20). The moulded piece C can be bought ready made from any dealer. Fig. 21 is an enlarged section of the glass doors. Draw the design on a board, and

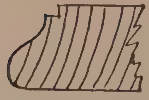


Fig. 17.—Section of Moulding

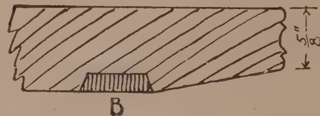


Fig. 18.—Part Section of Shelf

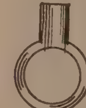


Fig. 19.—Shelf Support

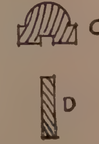


Fig. 20.—Section of Astragal

make up the four corners E (Fig. 22) with the pieces D (Fig. 20), dovetailing them together at the corners. The other pieces are next glued in position. All the joints should be strengthened by gluing on pieces of strong tape. Fig. 23 is an enlarged view of an angle piece joined to a square corner. The corners and middle pieces should be mortised to the edges of which the various mouldings are glued. The front and ends of the frame F (Fig. 25) are $3\frac{1}{8}$ in. wide by $\frac{3}{4}$ in. thick, and are dovetailed at the corners. The back of the frame is kept 1 in. in from the back, and is fixed with a dovetailed groove. The frieze G (Fig. 25) is $1\frac{1}{2}$ in. wide by $\frac{1}{4}$ in. thick, glued and mitred at the corners. The piece for the dentils H is next glued

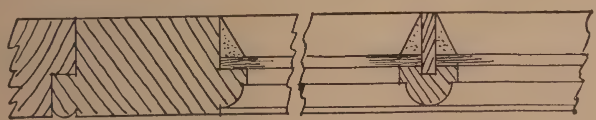


Fig. 21.—Enlarged Section of Glass Door

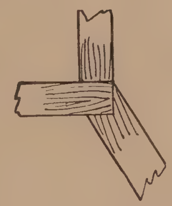


Fig. 23.—Enlarged Detail of Angle Piece on Door

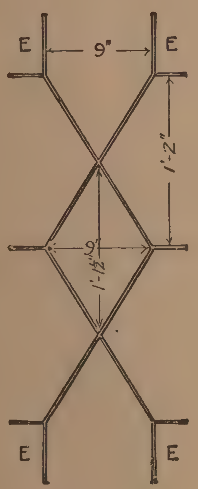


Fig. 22.—Detail of Construction of Glass Doors

Fig. 24.—Section of Moulding

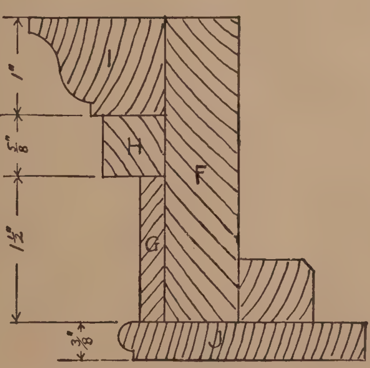


Fig. 25.—Enlarged Section of Cornice

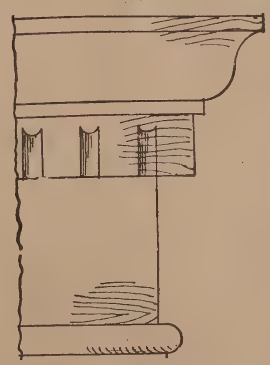


Fig. 26.—Enlarged Detail of Cornice

the stiles and rails. The moulded pieces are next glued to the pieces D, mitreing them at the corners, and to the sash moulding on the stiles and rails.

The glass is bedded in with putty, the latter being coloured to match the wood. A moulding (Fig. 24), $2\frac{1}{2}$ in. wide by $\frac{1}{2}$ in. thick, is mitred and glued to the top of the lower part of the bookcase to form a base for the upper carcase. The cornice consists of a separate frame of pine to to the top edge of the frieze, the dentils being cut with a gouge, as shown in Fig. 26. The top moulding I comes next, and the bottom piece J is glued to the edges of the frieze. Flush bolts should be fitted to the edges of the left-hand doors at the top and bottom. Brass locks and hinges to the doors complete the fittings for the bookcase, care being taken in their selection to see that their size is proportionate to that of the bookcase.

A BOOKCASE BUREAU

The bookcase bureau is a valuable type of furniture in both large and small houses, as it lends itself readily to decorative treatment, and its usefulness is beyond doubt of great value whether it is placed in the study or library of a large house, or in the living room of a small house or modest flat. There are but few homes where it is not desired to accommodate a few books or port-

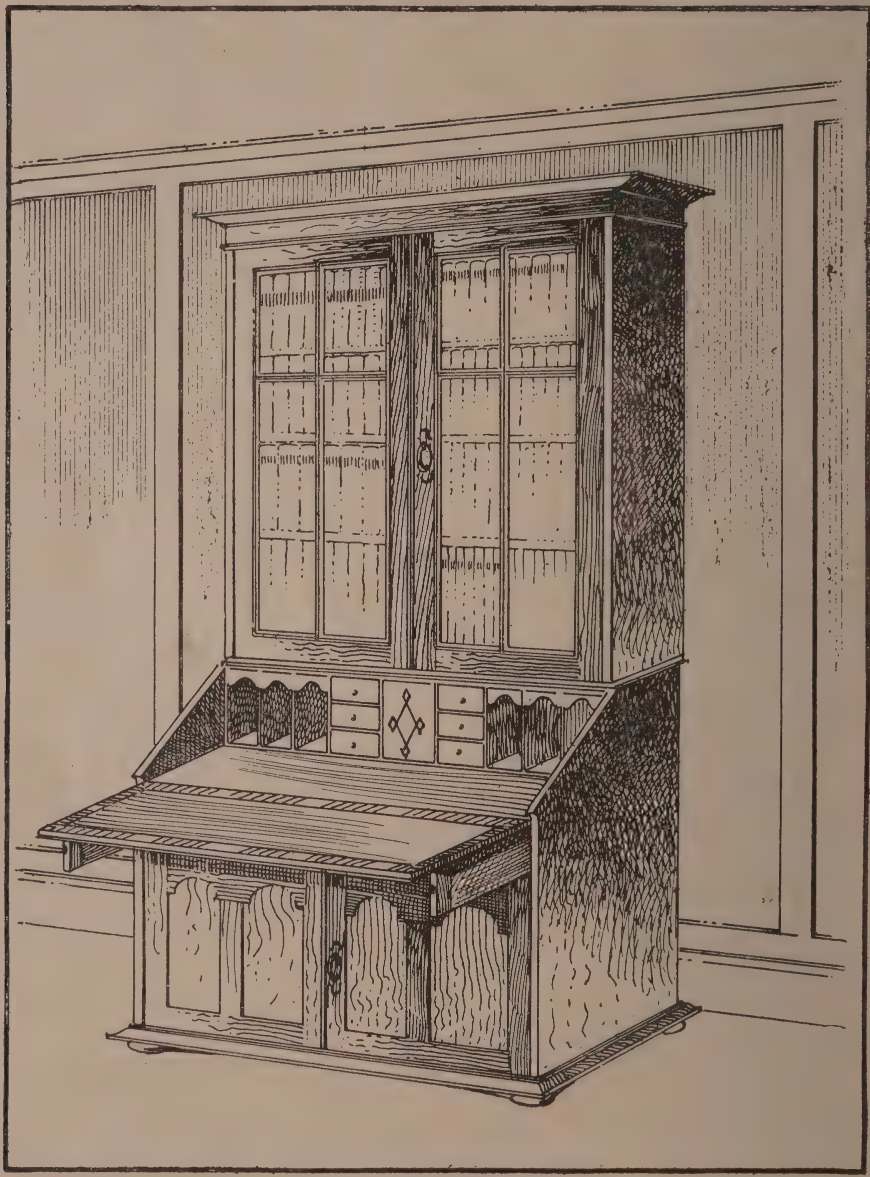


Fig. 27.—Bookcase Bureau

folios and the necessary equipment for writing.

To dip into the history of the bureau one has to traverse the three last centuries, for it was during the seventeenth century that the bureau as a separate piece of furniture was first produced. At the beginning of the eighteenth century the bureau was surmounted by a bookcase with glazed doors instead of the fitted cupboard; and later in the century Chippendale, Sheraton, and the other master craftsmen still further developed the bookcase bureau until they produced models which still stand to-day as the best of their kind.

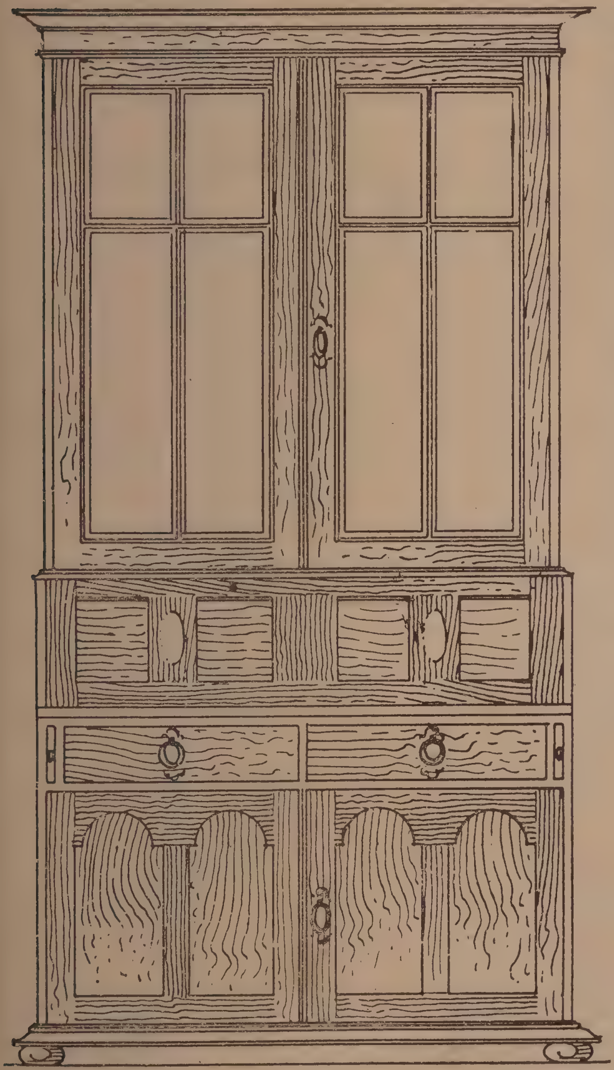


Fig. 28.

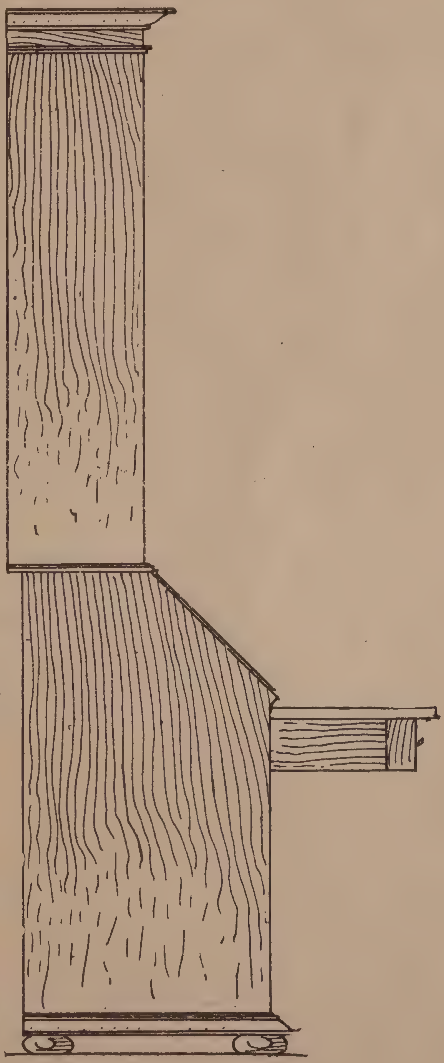


Fig. 29.

Figs. 28 and 29.—Front and Side Elevations of Bookcase Bureau

Fig. 27 is a reproduction of a perspective sketch of a modern bookcase bureau based on traditional lines, and embodying legitimate to take the decorative detail of an earlier period, and use it in conjunction with a later arrangement or type of

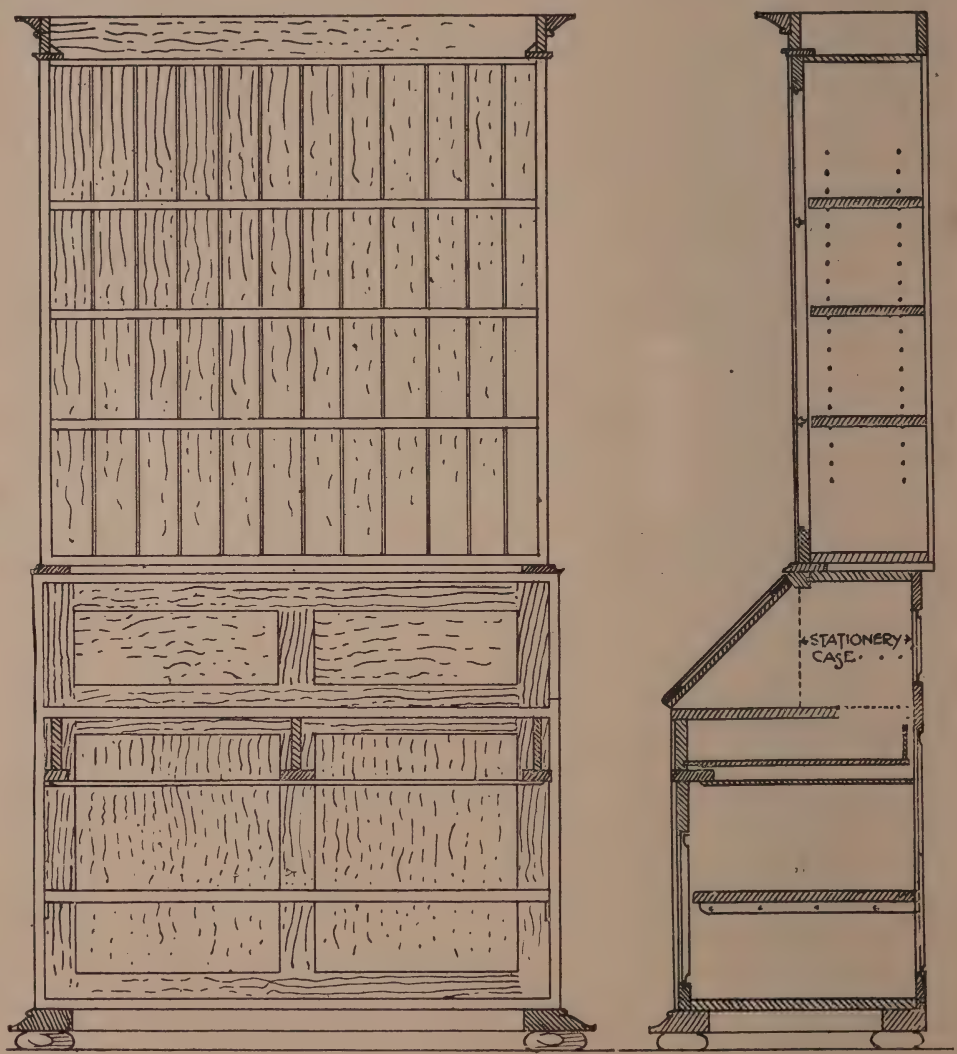


Fig. 30 Fig. 31.

Figs. 30 and 31.—Sectional Front Elevation and Vertical Section of Bookcase Bureau

some of the decorative features of the William and Mary period in the bottom part. It is generally recognised as quite furniture, such as has been done in the present instance. It forms a most useful and decorative piece of furniture, and

does not present any very difficult constructive features. Figs. 28 and 29 show the front and side elevations, and two sections are given by Figs. 30 and 31. An enlarged detail is shown (Fig. 32) of the bottom part of the carcase, the main feature of which is a heavy base moulding with turned ball feet.

The carcase should be made with the sides shaped, as shown in the perspective sketch (Fig. 27), with the table part slip-dovetailed in. A rail is tenoned in between the drawers and doors. The carcase bottom should be set back to allow the doors to close over the bottom, and the base mouldings can be mitred and screwed underneath the carcase bottom. The ball feet would, of course, simply be screwed up from underneath. Reference to the enlarged detail (Fig. 32) will show the actual arrangements of the tenons and mortises, which are reduced on the inside to allow the rebates to be cut. Fig. 33 shows a suggested arrangement for the stationery case; this should be made as a separate fitting, and placed in position from the back. It is usual to make it slightly shorter than is really necessary, and the small resultant spaces can then be filled in with beads to give it a neat appearance. The sliders or "loopers," as they are frequently called, which pull out in order to support the fall or writing flap, are shown in the end view of the bookcase bureau. They should be prepared of straight-grained wood tongued into the front pieces, or clamped as explained on a much earlier page.

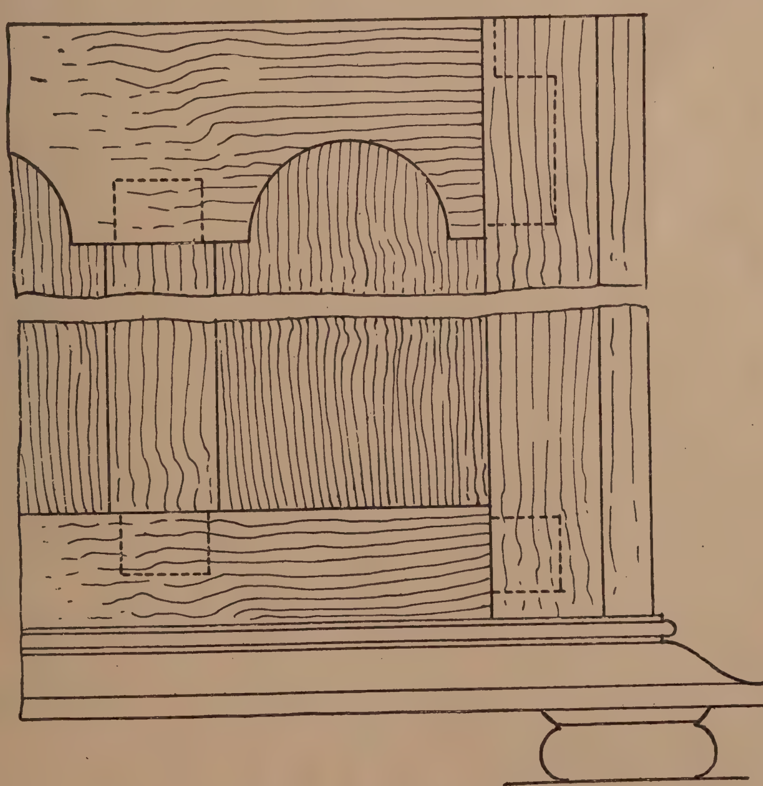


Fig. 32.—Detail of Construction of Lower Doors

It is a good plan to keep the straight-grained wood slightly under the front piece, so that the top edge can be covered with baize for the front of the fall to rest on.

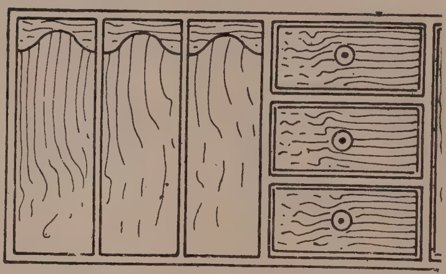


Fig. 33.—Part Front Elevation of Stationery Case

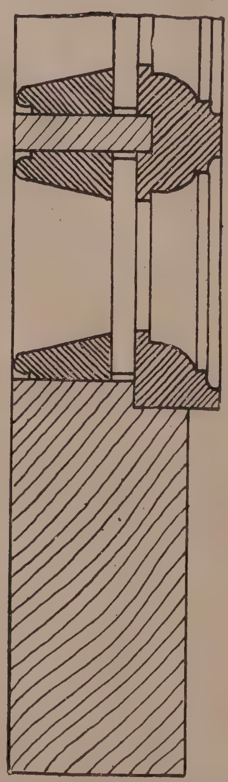


Fig. 34.—Enlarged Sectional Detail of Top Door

The bureau fall is fairly straightforward; it is panelled up, and is hinged to the table part. It is necessary to work rebates on both sides and the top edge, which leaves a projecting part to rest on the carcase edges. The fall is panelled up and made quite flush on the inside, and a lipping must then be made for the lining of the table part. Cross-banded saw-cut veneer about 1 in. wide, glued all round, provides an excellent lipping, and for the lining either billiard-table cloth or leather is suitable. If leather is employed, morocco stained and dressed to the required colour is the best to use; but for purposes of economy "roan" is largely used. Roan leather is similar to morocco in general appearance; but it is, of course, cheaper and inferior in quality. A still cheaper treatment is to use "skiver" material; but its use is not recommended, as there is not much substance in the material, and it soon gets rubbed and presents a dingy appearance. It is usual to have tooled borders to the lining, which must be done by a properly qualified table liner. These borders are made by means of heated dies pressed into the surface of the leather, which impress the leather with a pattern. The pattern is frequently gilded; but a good appearance is effected by leaving the pattern quite plain, which is commonly known as "blind tooling."

The construction of the upper carcase or bookcase part is straightforward. Both the carcase top and bottom should be lap-dovetailed into the carcase ends, and the base moulding attached to the bureau or bottom part. A matched back is illustrated as an alternative to a panelled back. The latter is the most satisfactory, as it keeps the carcase quite square and rigid; but if care is taken with a matched back it is quite satisfactory. In Fig. 34 is shown an enlarged working detail of the door frame. Ordinary oblong frames are made to the required size, with rebates on the inside edges. Bars or slats are then fitted into the design shown, and the mouldings

then mitred into the rebates; the cross mouldings also are mitred and glued on to the bars or slats. At the centre an astragal moulding is rebated into the left-hand shutting stile, and fitted over the left-hand door to conceal any opening. In the sectional view is indicated the arrangement for adjusting the shelves to any required spacing; $\frac{3}{8}$-in. holes are bored $1\frac{1}{2}$ in. from centre to centre, and wooden struts or pins are made to fit in. The outside of the stud should be made about $\frac{1}{2}$ in. in diameter, and this leaves a shoulder or collar to prevent it passing too far into the prepared holes. Boxing up is employed for the cornice, which is completed by adding the frieze moulding on the oak.

The completed job should be fumed with ammonia, and then slightly french-polished to fix the colour. A good tone may be imparted to the work by finishing off with a mixture of wax and turpentine, rubbed well in with soft cotton rags until a good, even polish is obtained.

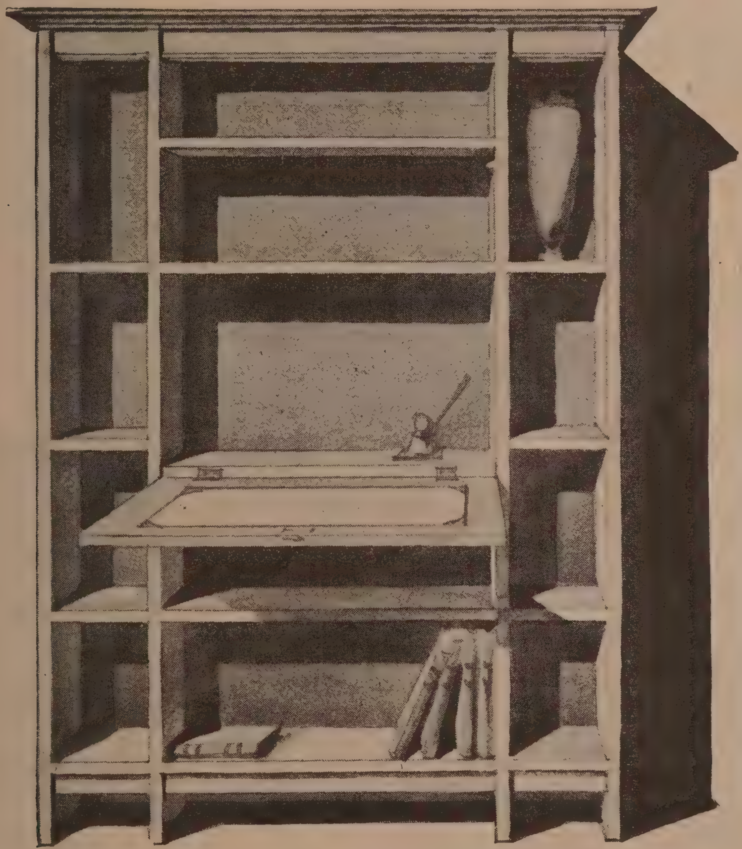


Fig. 35.—Simple Bookcase Bureau

SIMPLE BOOKCASE BUREAU

The half-tone reproduction (Fig. 35) together with the dimensioned detail drawings are sufficiently explanatory of this simple bookcase bureau without further description. Two elevations, front and half back, are given by Figs. 36 and 37, and Fig. 38 shows a vertical section.

From a study of the drawings it will be seen that the construction is on particularly simple lines. Figs. 39 and 40 show the methods of fixing the shelves and top, and it will be observed that all joints are avoided. A detail of the hinged writing flap is shown by Fig. 41. The shelf to which the flap is hinged is housed into the two centre uprights, as shown by Fig. 42. Fillets are let into the backs of the four uprights A B C D (Fig. 36), these latter being notched for this purpose, as shown by the detail (Fig. 43). The positions of the fillets are clearly shown in the sectional view (Fig. 38).

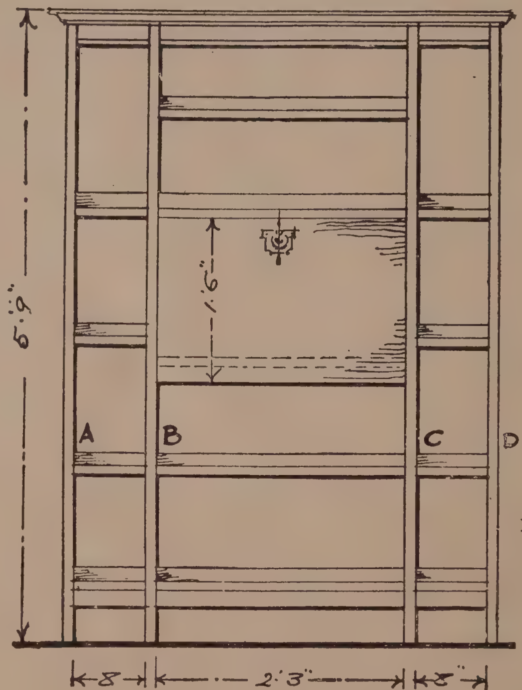


Fig. 36.

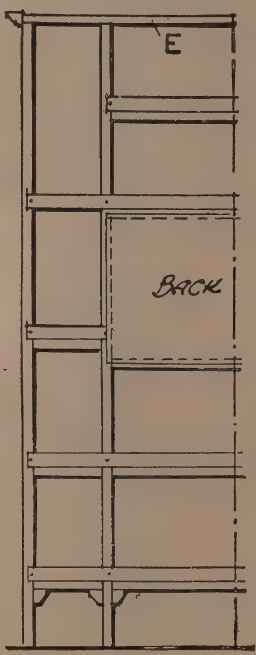


Fig. 37.

Figs. 36 and 37.—Front and Half Back Elevations of Bookcase Bureau

FITTED BOOKCASE CABINET

The modern house usually has one or more pieces of fitted furniture, and though this usually takes the form of a wardrobe there is no reason why a bookcase should not come under the arrangement. Fitted furniture is economical because of its simple construction, and it provides good accommodation in recesses and corners where in the usual way a good deal of space is lost. Where such work is introduced by the builder or owner as a permanent feature of the house, much less work can be put in than is indicated in the bookcase shown by Fig. 44 and which has panelled backs. Figs. 45 and 46 show front and back respectively.

The fitment should be made in two parts. The bottom part should have a bottom grooved into both the pilasters with the projecting square part supported on fillets attached to the wall, like a low

skirting board. A carcase top rail about 8 in. wide should be dovetailed into the pilasters in order to keep them in proper position, and the moulded parts should be made to fit the front part and also the wall line. This is attached to the front rail, and may be supported in the angle by means of wall fillets. It will be seen

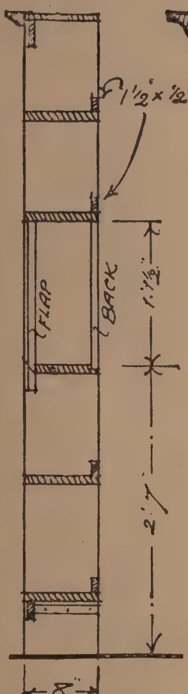


Fig. 38.—Vertical Section

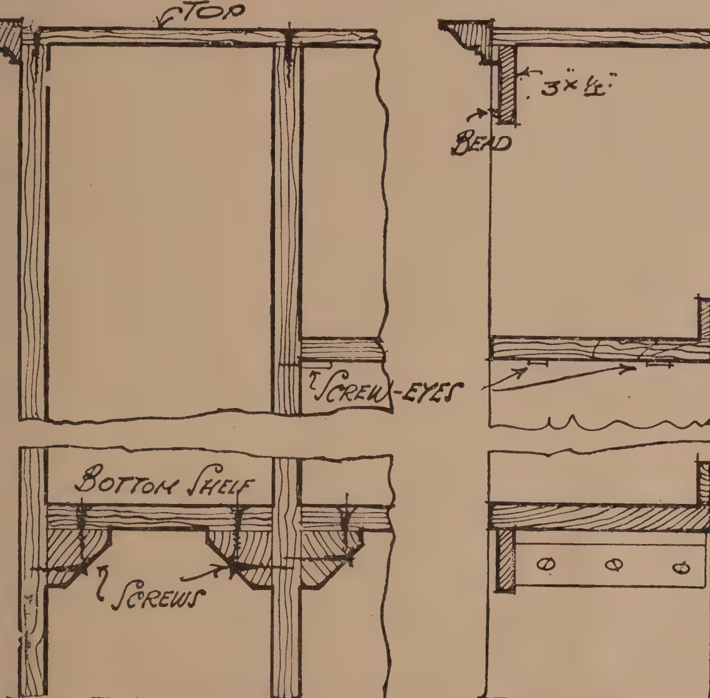


Fig. 39.

Fig. 40.

Figs. 39 and 40.—Vertical Sections through Cornice, Shelves, etc.

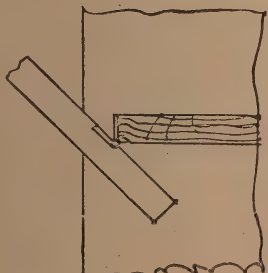


Fig. 41.—Detail of Flap

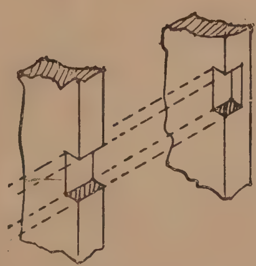


Fig. 43.—Uprights Cut for Fillets

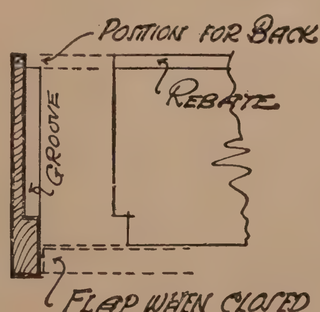


Fig. 42.—Detail of Shelf Housed to Upright

that after the bottom carcase has been fixed to the wall, a skirting board is mitred round, the top edge of the moulding being made level with the top side of the bottom carcase. The door frame is fairly simple, and for painted work it should be made with through mortise-and-tenoned joints. A bolection moulding is then mitred round in order to form a rebate to receive the panel.

Fig. 44.—Fitted Bookcase Upright

To construct the upper portion a full top should be employed similar to that used for the shelf of the top part. The top should be dovetailed down and the shelf should be grooved into the pilasters on the inside. Both should be supported in the angle by means of narrow bevelled fillets. The arch should be fitted between the pilasters, and to make a neat job it should be laid over the edge of the top, necessitating the latter being set back. A full cornice is hardly necessary. A rail the full width of the frieze and cornice moulding should be mitred together, tongued and blocked, and then the frieze and cornice mouldings can be mitred round and glued. When quite dry it can be screwed in position from the inside. It should here be mentioned that the pilasters are intended to be dowelled down into the moulded bottom, thus obviating the necessity for an additional solid bottom.

The barred doors in the top part should first be dry mortised and tenoned with a wide rail to allow the curves to be cut from the solid. Long and short shouldered mortise-and-tenon joints are necessary in order that the shoulders will fit both the sight line and also the rebate. A straight bar should then be tenoned into the top and bottom rails. When carefully fitted, this should be removed and the two short bars likewise fitted. These also can then be removed and the halving completed preparatory to gluing up the doors with the bars in position. When the doors are dry the front bar mouldings can then be mitred and glued to the bars. Astragal mouldings are usual with such work, but for painted work they look quite well if made flat, the sharp edges being rounded off after the doors have been glasspapered. An astragal moulding should be fitted to the right-hand door in order to overlap the shutting stile of the left-hand one.

The construction of this bookcase cabinet as a separate piece of furniture is shown in the drawings (Figs. 47 to 49). It will be seen that back frames are introduced to give the necessary rigidity. At B (Fig. 47) is shown a part plan of the plinth frame. This is through-dovetailed in the angle, and the two short returns should have lap dovetails. The centre front piece is then mitred and tongued to the two short returns. Afterwards the moulding is mitred round as indicated in the part plan, and if the long rails are made rather wider, they can be notched to receive the moulding and thus yield a level surface on top without the necessity for gluing on separate slips.

The portion of this figure marked A shows a section through the bottom part. Figs. 48 and 49 are enlarged details of

this part. The backs are panelled as shown, and a solid top should be dovetailed into the pilasters and screwed down to the backs.

receive the shelf, which should also be sub-tenoned into the edges of the pilasters. This should be finally secured by screwing the shelf through the backs.

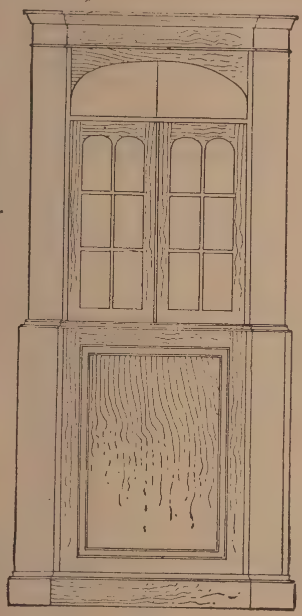


Fig. 45.

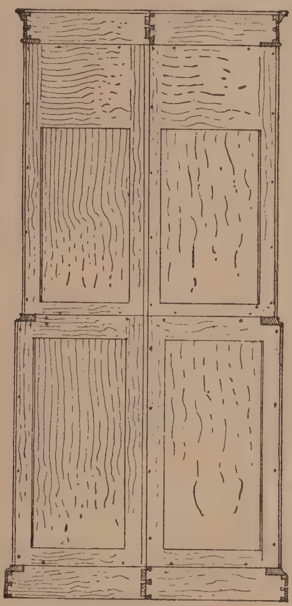
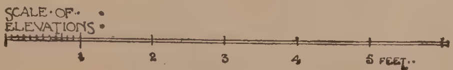


Fig. 46.

Figs. 45 and 46.—Front and Back Elevations of Bookcase Cabinet



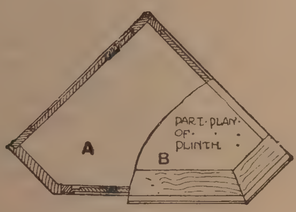


Fig. 47.—Part Plan of Bottom Cupboard

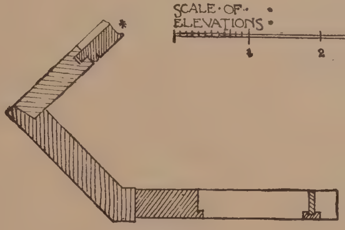


Fig. 48.

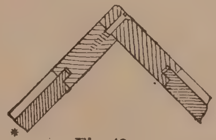


Fig. 49.

Figs. 48 and 49.—Enlarged Details of Bottom Cupboard

The bottom is dealt with similarly. The base moulding of the top part should be made about 3 in. wide and mitred round to show as indicated. The top carcase should be constructed similarly to the bottom, and the centre part should be cut away to receive the arch. It is also necessary to groove the pilasters to

The cornice is made as a box with the frieze moulding glued round on the underside. The back view shows the cornice moulding glued round to form a rebate at the top which receives a dust-board. Shelves about $\frac{5}{8}$ in. thick should be fitted on fillets, the front edges lining up with the bars.

Hall Furniture

SMALL HALL TABLE

A SMALL table, suitable for the hall, that may be made of bass wood, American whitewood, or any similar softwood, is shown by Fig. 1. Front and side elevations and vertical section and plan are shown by Figs. 2 to 5.

The pieces required should be faced true, and gauged and planed to a thickness of about $\frac{3}{4}$ in., after which the curves should be marked and sawn out, and the fret ornament cut. Some of the straight parts which join the curves should be finished with the chisel and a small thumb-plane or spokeshave; generally this will be found more satisfactory than trying to finish with a file. The large curve can be finished with a spokeshave, and the smaller ones with a file, or these may be worked by overhand paring with a keen chisel and finishing with No. 1 glass-paper. The thumb moulding shown round the edge of the top may be worked by means of a scratch tool. The two standards are connected by means of a 2-in. by $\frac{3}{4}$-in. rail, as at A (Fig. 2), and have mortises that allow a whole-thickness tenon to pass through, and they are finally secured with small oak wedges. The top on its underside is grooved to a depth of about $\frac{1}{4}$-in., so as to receive the top ends of the standards. The top and the standards can be fixed rigidly together by gluing a few angle blocks to them. The back piece and the top are secured with glue, and by inserting a few screws from the back. The front rail B (Fig. 2) should be fixed to the standards and top by angle blocks glued in the inner angles, and by driving in a few small sprigs or screws after the glue has set. It has a hole about $3\frac{1}{2}$ in. by 13 in. for the drawer in the centre. The top should overhang at the back a little, as shown at C (Fig. 4).

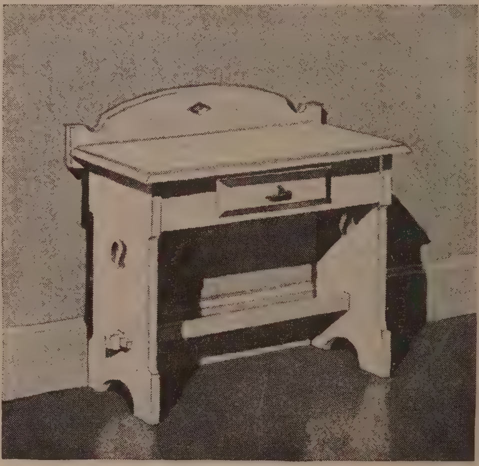


Fig. 1.—Small Hall Table

The drawer (Figs. 5, 6 and 7) has a chamfered front, overlapping the hole in the front rail to the extent of $\frac{1}{2}$ in. all

round. Its sides and bottom should be housed ¼ in. into the front, as in Fig. 6. The runner D (Fig. 7) is rebated or built up of two pieces as shown, so as to receive a suitable handle should be screwed on, and the table may be finished in any of the usual ways.

The design for the fret ornament in the

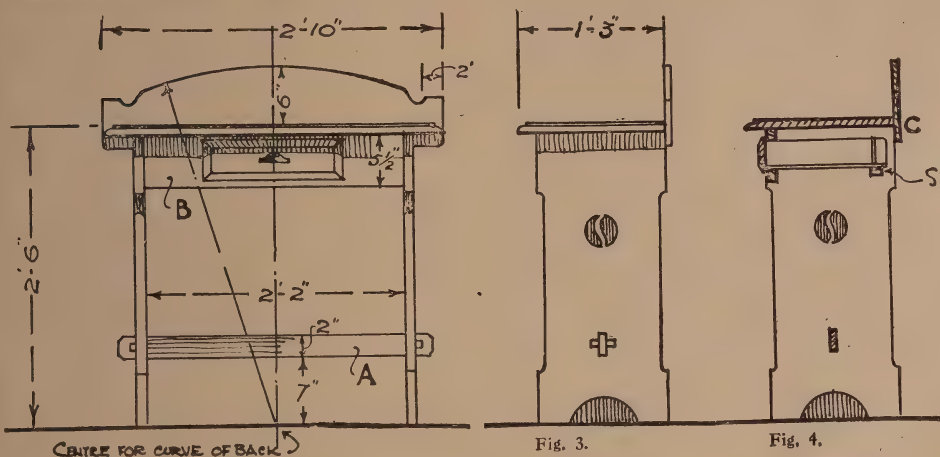
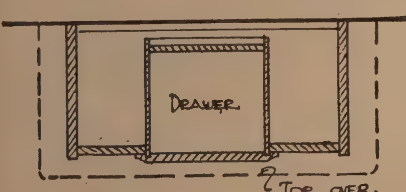
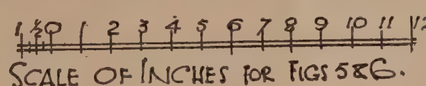


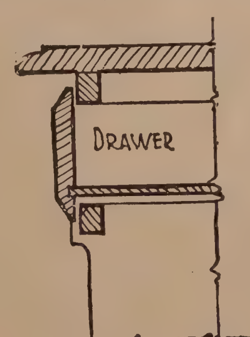
Fig. 2. Fig. 3. Fig. 4.

Figs. 2, 3 and 4.—Front and End Elevations and Vertical Section of Hall Table



Figs. 5.—Plan through Level of Drawer





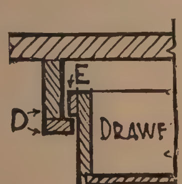


Fig. 7.—Detail of Drawer Runners

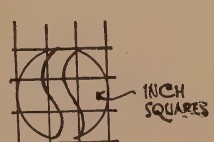
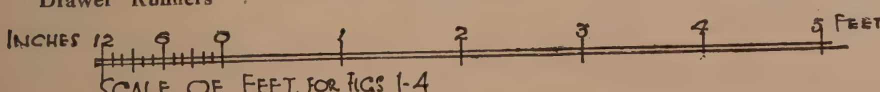


Fig. 8.—Design for Ornament

Fig. 6.—Detail of Drawer Front



fillet, which is glued and sprigged on to the sides of the drawer, as shown at E. The drawer should fit quite loosely, and can have a stop, as noted in Fig. 4, to prevent its being pulled too far out. A standards is shown by Fig. 8. The half-tone reproduction (Fig. 1) shows a diamond-shaped piercing in the middle of the back top piece, which might be added if desired.

SHELF BRACKET FOR HALL

A useful shelf bracket for the hall is illustrated by Fig. 9. Figs. 10, 11 and 12 show front elevation, vertical section and plan.

The two side supporting pieces are cut from $\frac{3}{4}$-in. or 1-in. stuff set out as shown in Figs. 13, 14 and 15. These drawings can easily be enlarged to full-size by means of the inch squares into which they have been divided. The scrollwork is cut with a band-saw, the rough edges being afterwards cleaned with a spokeshave, file, and glasspaper. Two rails, as at A and B (Fig. 11), connect the supports, being let into them and fixed with 1-in. screws. The lower rail should be immediately above the skirting of the hall. The shelf is finished to 10 in. by $\frac{7}{8}$ in., moulded on the exposed edges, and fixed to each support with $1\frac{1}{4}$-in. screws. Under its front edge and $\frac{1}{4}$ in. behind the front top edge of the uprights is fixed a $1\frac{1}{2}$-in. by $\frac{3}{4}$-in. front rail as at C. This can be secured either by means of blocks at the back, or by letting it $\frac{1}{4}$ in. into the uprights at its ends.

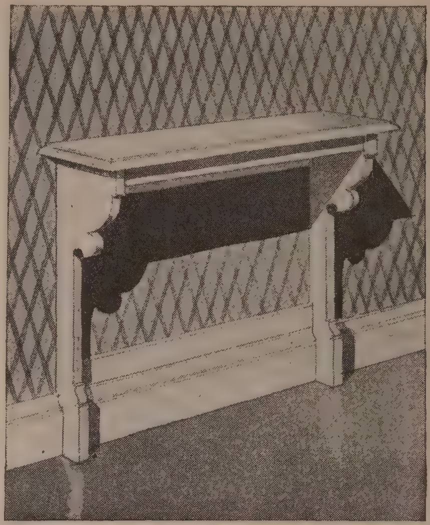


Fig. 9.—Shelf Bracket for Hall

The bracket is fixed to the wall by means of screws driven through the rails into wooden plugs fixed in the wall, the supports being cut away to fit over the skirting. Fig. 14 shows how, when the outline of the shaped support has been set out once, it can be traced and reversed as at D, this enabling the pair to be cut very economically from one piece of wood; this method also ensures symmetry and continuity of curve.

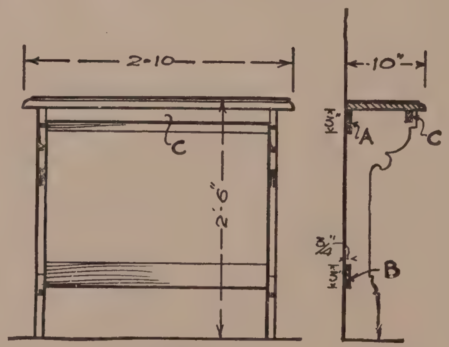
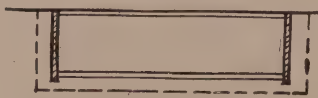


Fig. 10. Fig. 11.



Scale: $\frac{1}{2}$ in. = 1 ft.

Fig. 12.

Figs. 10, 11 and 12.—Front Elevation, Vertical Section and Plan of Shelf Bracket

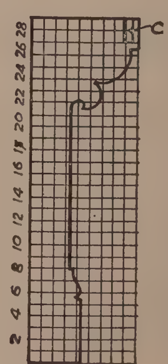


Fig. 13.

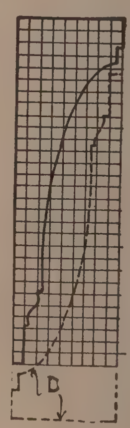


Fig. 14.

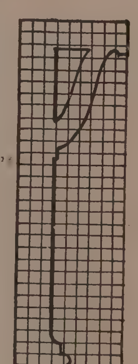


Fig. 15.

Figs. 13, 14 and 15.—Three Designs for Supports and Method of Setting Out

HALL TABLE

The dimensions of the hall table shown by Figs. 16, 17 and 18 are 3 ft. 4 in. by 2 ft. by 2 ft. 4 in. high; but these may be altered as desired, if proper care is taken to do so proportionately. The table essentially consists of two framed ends with shaped stiles, connected by longitudinal rails at their heads, and strutted apart by a single stretcher with pinned tenons, allowing the shoulders to be drawn close. Each end frame consists of the following parts: head, 3 in. by $2\frac{1}{4}$ in.; foot, $3\frac{1}{2}$ in. by $2\frac{1}{4}$ in. (both with shaped overhanging ends); two stiles with shaped outer edges out of 4-in. by $1\frac{3}{4}$-in. material; a cross-rail, 3 in. by $1\frac{1}{4}$ in., at a height of $10\frac{1}{2}$ in. from the floor; and a curved spandrel filling to the head out of 5-in. by 1-in. material. The remaining parts to complete the frame are: head stretchers, 3 in. by $2\frac{1}{4}$ in.; single intermediate stretcher, 3 in. by $1\frac{3}{4}$ in.; pendant pieces, $1\frac{3}{4}$ in. square; and spandrel fillings of the same depth as in the end frames.

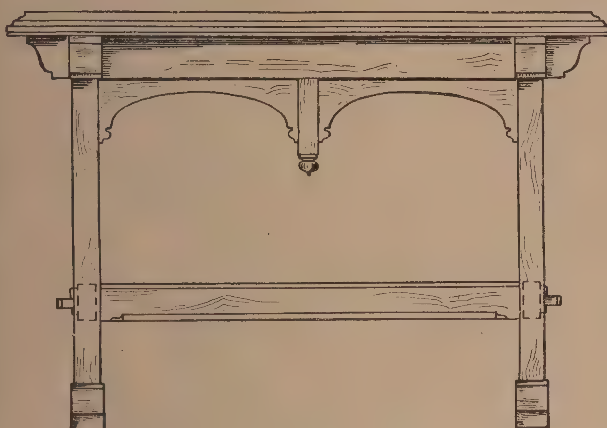


Fig. 16.

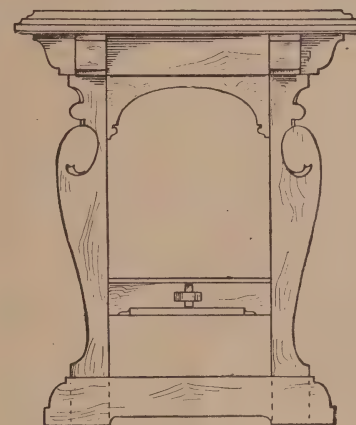


Fig. 17.

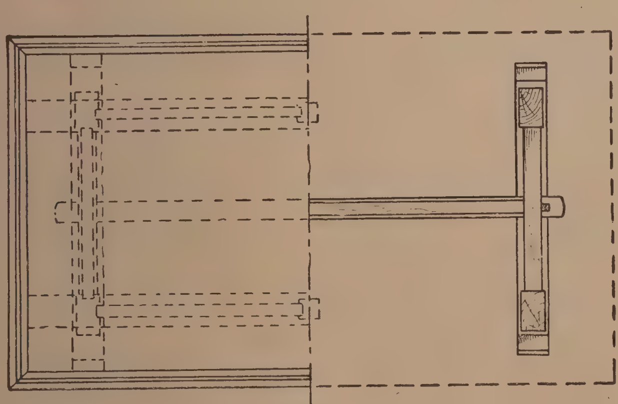


Fig. 18.

Figs. 16 and 17.—Front and End Elevations of Hall Table

Fig. 18.—Half Plans of Top and Legs

The method of construction is as follows: The material for the whole is prepared to dimensions, and the templates for the shaped parts cut in cardboard (or if for repetition work in thin wood). Taking

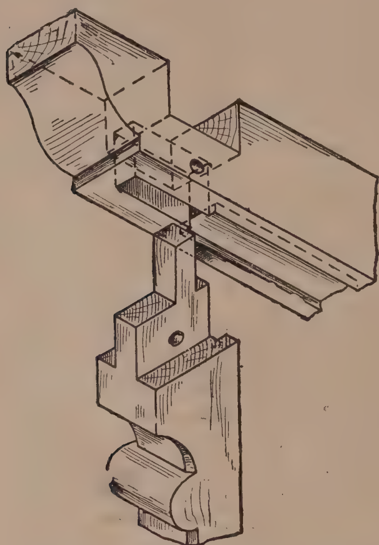


Fig. 19.—Enlarged Detail of Head Rail and Leg

first the end frames, set out the head and foot rails by measuring to dead lengths, marking the position of mortises, housing and halvings (*see* Fig. 19), and tracing out the moulded ends and sinkings to the centre of feet. Similarly mark out the stiles and cross-rails for tenoning, mortising and housing, with the outline of the outer edges of the stiles. Treat the stretchers in the same way, using throughout a scribing knife for the shoulder lines, and mortise gauge for mortises and tenons. Set out the pendant pieces (providing for a wedged tenon through the top rail), and also the spandrel fillings for the whole.

Begin work by preparing the principal mortises and tenons. Afterwards cut the halvings and the small mortise through the halving of the long rails. Sink the housings for the spandrels, then follow with the moulded ends, etc., to rails, and shaped edges to the stiles. Groove the top rails to receive the fixing buttons for securing the top. Next chamfer the cross-rails (in the end frames) and the single stretcher; "square turn" the drops to the pendant pieces, try the whole frame together, and, if satisfactory, clean up the parts ready for assembling. Glue and wedge up the end frames, cutting back the tenon ends $\frac{1}{8}$ in., so that subsequent shrinkage will not cause them to bear on the floor. Connect the end frames with the stretcher, gluing and draw-pinning as in Figs. 16, 17 and 18. Wedge the pendant pieces to the top rails, again cutting back the tenons and wedges slightly to prevent bearing against the top. Slide the spandrels into position sidewise, then drop the top rail and its connected parts into the halvings and housings prepared for them (gluing the halving and tenon), and finally wedge the latter and cut back slightly as before. If oak or pitch-pine is used for the frame, every tenoned joint should be also neatly pinned with $\frac{3}{8}$-in. diameter pins (preferably draw-bored) within $\frac{5}{8}$ in. from the shoulder.

The top is now prepared from $\frac{7}{8}$-in. material, and, if possible, in one piece. The dimensions given in this case would usually entail jointing, which should be grooved and cross-tongued, with the grooves stopped short of the ends, and 3-in. by $\frac{3}{8}$-in. dowels placed at each end

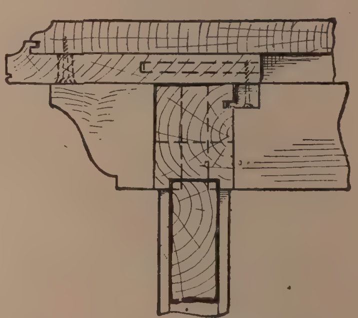


Fig. 20.—Enlarged Detail of Top

(near to the moulded edge), and at 9-in. intervals along the joint. Underneath this $\frac{7}{8}$-in. surface piece is a moulded margin prepared from $1\frac{1}{4}$-in. stuff, of a width sufficient to extend $1\frac{1}{2}$ in. beyond the frame inwards. This margin is tongued

at the edge as shown, being reduced to $\frac{7}{8}$ in. thick, and fixed to the top by one row of slotted screws, as in Fig. 20, and the long margins connected by one or more cross stretchers, mortised and tenoned, but not glued, and left $\frac{1}{8}$ in. clear at the shoulders. A single screw at the centre of this length keeps the top from lifting, and ensures shrinkage or expansion equally in each direction. The whole of the top thus prepared is fixed to the frame with small hardwood turn-buttons, tongued into the grooves previously prepared in the top rails. The top as completed with the margins is then perfectly free to expand or contract without deterioration to mitres or damage to top surface. Care should be taken to choose material whose grain gives no tendency to lift at the edges (*see* Fig. 20), or otherwise the tongued-edge joint must be strong enough to prevent it.

The table might be suitably constructed either entirely in oak or mahogany, or with oak or pitch-pine frame and mahogany top. In any case, well-seasoned and dry material is essential.

HALL TABLE WITH FRETTED ENDS

A hall table of entirely different style and construction to the one just described, is shown by the photographic reproduction (Fig. 21). The dimensions and details necessary for making it are clearly shown by the drawings, (Figs. 22 to 27). Suitable woods to use are either black walnut or mahogany. The legs are of $1\frac{1}{2}$-in. square stuff, tapered off equally all round below the drawer rails, the reduction being to 1 in. at the neck of the foot, which is shaped and slightly rounded underneath as shown. At the ends the legs are connected by means of a rail A

Fig. 21.—Hall Table with Fretted Ends

1 in. thick and 7 in. deep, stub-tenoned in position, and at the top by a rail B $1\frac{1}{2}$ in. by $\frac{3}{4}$ in. deep, as in Fig. 23, slightly tenoned to their uppei extremities. The deep rail A should be flush on the inside with the legs, as it will form one side of the drawer space. The void between A and B is filled in with a $\frac{1}{4}$-in. hardwood panel, fretted to a very

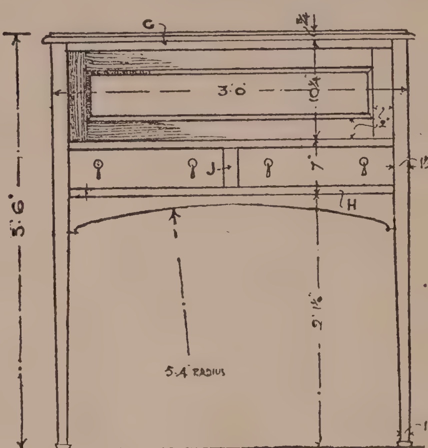


Fig. 22.

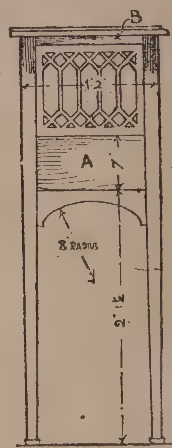


Fig. 23.

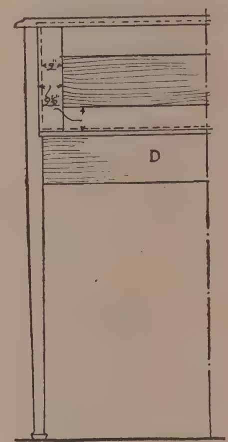


Fig. 25.

Figs. 22 and 23.—Front and End Elevations of Hall Table

Fig. 24.—Two Sectional Half Plans at Top and on Drawer Level

Fig. 25.—Half Back Elevation

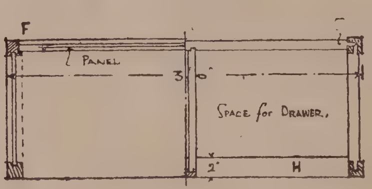


Fig. 24.

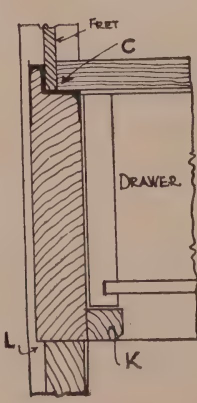


Fig. 28.—Detail Section through Rail

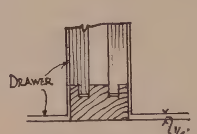


Fig. 29.—Detail of Division between Drawers

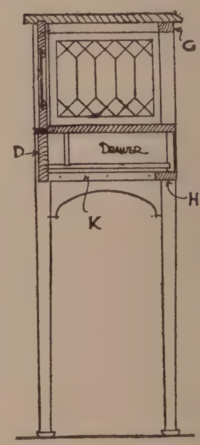


Fig. 27.—Cross Section

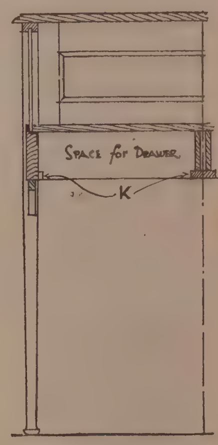


Fig. 26.—Half Horizontal Section

simple geometric pattern, and fitted into grooves in the legs and top rail and into part of a rebate, as at C in Fig. 28.

At the back the legs are joined up first of all by means of a $6\frac{1}{4}$-in. rail, as at D in Figs. 25 and 27, tenoned as at E in Fig. 24. Over this and into the rebates at the ends C (Fig. 28) fits a $\frac{3}{4}$-in. lower shelf, having all its edges flush with the outer faces of dovetailed to the tops of the front legs. The top shelf is secured by oblique screwing from behind the various rails. Before this can be done, the 2-in. by $\frac{3}{4}$-in. drawer rail H (Figs. 22, 24 and 27) must be framed in position, and also a vertical division as at J (Fig. 22). If this is made $1\frac{1}{2}$ in. wide as shown, to match the legs, it can be built up as in Fig. 29, the upright J

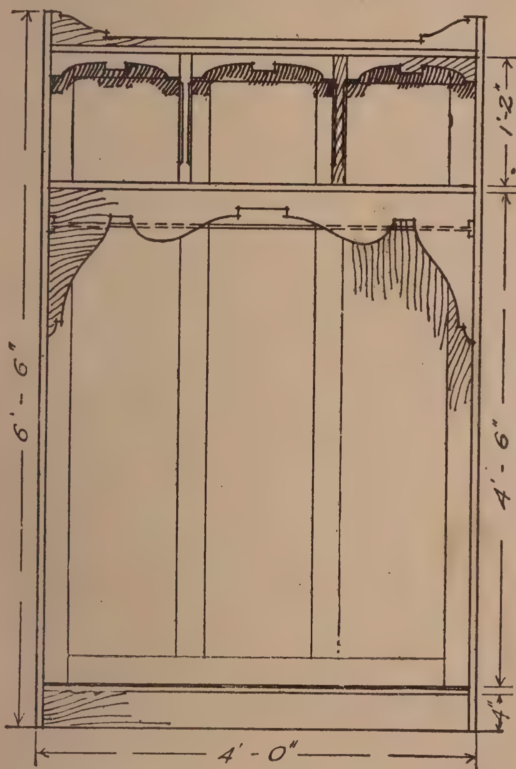


Fig. 30.

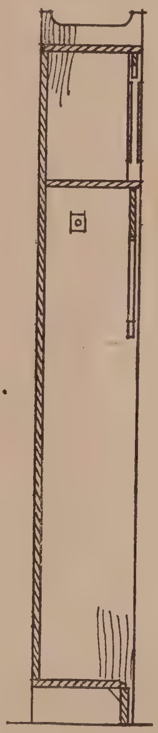


Fig. 31.

Figs. 30 and 31.—Front Elevation and Vertical Section of Hall Wardrobe and Hat Rack

the legs, round which it is cut and into which it should be notched $\frac{1}{4}$ in. deep. Its top back edge is rebated as just above D (Fig. 27) to take a long narrow piece of $\frac{3}{4}$-in. moulded and panelled framing, let into rebates in the back legs F (Fig. 24) and with its top housed slightly into the top shelf, which is $\frac{3}{4}$ in. thick and moulded. This shelf is finished along the front with a $1\frac{1}{2}$-in. by $\frac{3}{4}$-in. rail G (Figs. 22 and 27) being stub-tenoned top and bottom. As a matter of fact, this could be reduced to one thickness of about $\frac{3}{4}$ in., thereby simplifying the work. It must be let into the back rail, and oak runners for the drawers should be screwed on, as at K in Figs. 26, 27 and 28. There is nothing special about the drawers, which it will be best to arrange $\frac{1}{16}$ in. or so behind the framing when closed. The only portion

not already described is the set of three arch or spandrel pieces, which are cut out of stuff $3\frac{1}{2}$ in. by $\frac{5}{8}$ in. to curves of the radii given in Figs. 22 and 23. They should be housed $\frac{1}{4}$ in. into the legs at the ends, and butted against the rails above them, their faces being $\frac{1}{8}$ in. behind those of the rails L (Fig. 28). All the parts should be fitted together complete, then taken to pieces, and all except the outside surfaces of the legs bodied in with polish, glued up, cleaned off where necessary, and the polishing finished.

Should a larger table be desired, this

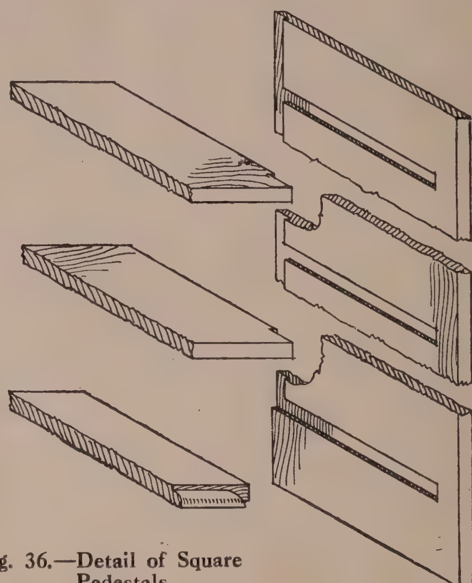


Fig. 32.—Side Piece and Shelves showing Joint

Fig. 35.—Details of Framed Panelling

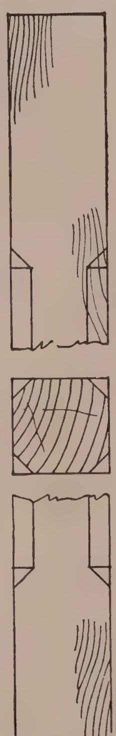


Fig. 36.—Detail of Square Pedestals

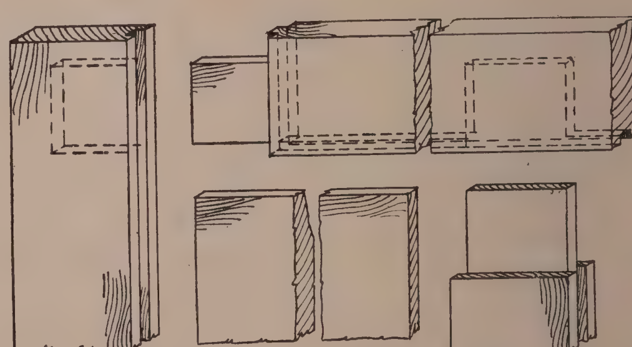


Fig. 33.—Joints of Back Panelling

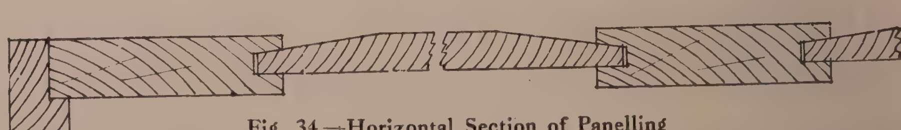


Fig. 34.—Horizontal Section of Panelling

design might be increased in height, and ties or rails introduced between the legs about 9 in. above the floor; or another shelf could be introduced at this level. Solid panels to match that of the back might be substituted for the fretwork, or this could be introduced at the back as well.

HALL WARDROBE AND HALL RACK

The useful piece of furniture shown in front elevation and section by Figs. 30 and 31 is especially designed for holding ladies' and gentlemen's hats as well as other clothing. A good appearance will be given if it is finished with white enamel. It is very light in construction, all the boards being made of material finished at $\frac{3}{4}$-in. thickness. Bass wood or good yellow deal is recommended for strong and light construction. If yellow deal is used it can be obtained approximately 11 in. wide, and should be of good quality.

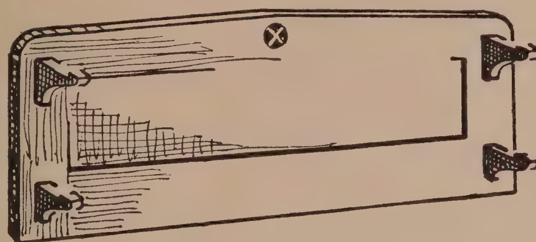


Fig. 37.—Hall Rack

First prepare the two side boards, and mark the three grooves in each piece to receive the shelves. These grooves are $\frac{1}{4}$ in. deep, and are stopped $1\frac{1}{4}$ in. from the front edge. The back edge is then rebated $\frac{3}{4}$ in. wide, to the same depth as the grooves to receive the frame for the back panelling and the wall piece at the top. The shelves are next prepared, and are 3 ft. 11 in. long, the pieces being notched out to fit the stopped grooves. It will be seen that the top shelf is made the full width of the side boards, the middle shelf $\frac{3}{4}$ in. narrower to allow for the back panelling, and the lower shelf $\frac{3}{4}$ in. narrower in the front, the edge being moulded. Fig. 32 shows the grooves in the side pieces and the shape of the shelves. The patterns at the top ends of the side boards are then cut to shape, and all pieces smoothed up and fixed together. For rigid fixing, the joints should be glued and nailed with $1\frac{1}{2}$-in. oval brads.

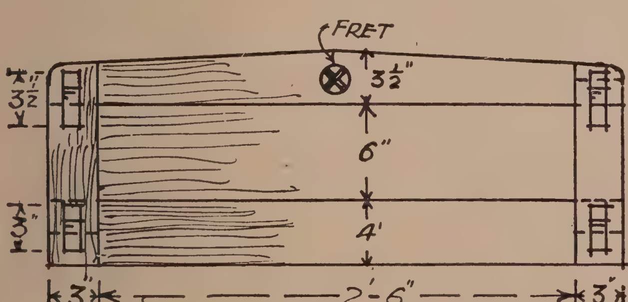


Fig. 38.

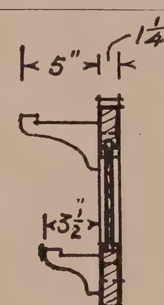
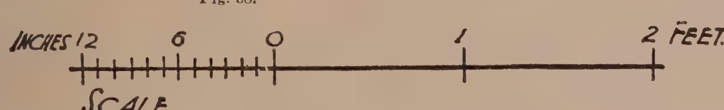


Fig. 39.



Figs. 38 and 39.—Front Elevation and Vertical Section of Hall Rack

The back frame, which fits between the top and bottom shelves, is made of material finished at 3 in. wide and $\frac{3}{4}$ in. thick. The tenons need not be carried right through, and allowance is also made for the $\frac{5}{16}$-in. plough grooves, which should be about $\frac{3}{8}$ in. deep, as shown in Fig. 33. The panels should be $\frac{1}{2}$ in. thick, and bevelled at the back to fit the plough grooves. They should be fitted so as to allow for any expansion or shrinkage in their widths, as shown in Fig. 34. Fig. 35 shows the framed panelling ready for fixing. Glue and fasten with brads or fine screws. The $1\frac{1}{4}$-in. square pedestals (*see* Fig. 36) for the hat racks are then fitted in and bradded. A brass rod with sliding coat-hooks is then fixed with small blocks as shown. The toe piece is fitted and fastened beneath the edge of the bottom shelf. The top wall piece is then cut to shape and fastened. All the ornamental brackets are $\frac{5}{8}$ in. thick, and fixed with glue and brads $\frac{3}{8}$ in. from the front edges of the wardrobe.

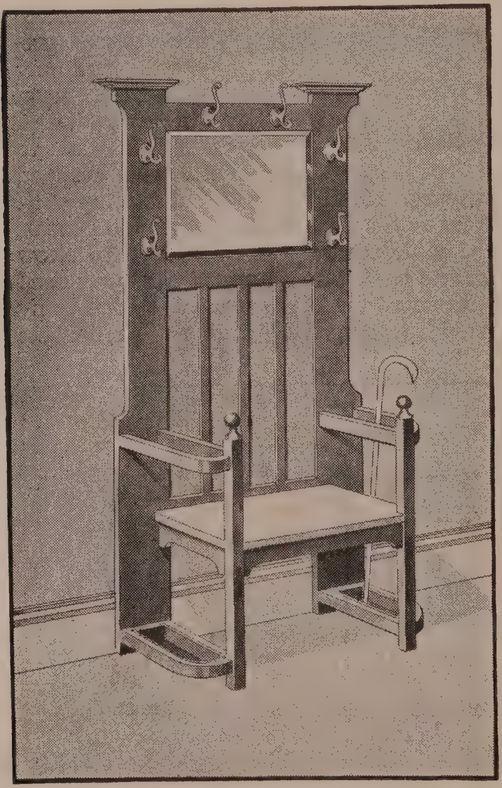


Fig. 40.—Hall Stand and Seat

HALL RACK FOR STICKS

The simple rack shown by Fig. 37 is primarily intended for the accommodation of sticks, golf-clubs, etc., but with slight modification it could be utilised for other purposes. For instance, rails might be put across the brackets and it then could be used for hats. Fig. 38 is a front elevation and Fig. 39 a vertical section. The construction is so apparent that further description is unnecessary. The choice of wood is a matter that can be left to the taste of the maker.

HALL STAND AND SEAT

Oak fumed and wax-polished should be used for the hall stand and seat shown by Fig. 40.

Front, side and back elevations are shown by Figs. 41, 42 and 43 respectively.

The stand is made with a framed and panelled back, to the upper part of which a bevelled-edge mirror is fitted. The seat projects from the framed back, and is supported by front legs, which are connected to the back by framework.

The framed and panelled back is made with two stiles A (Fig. 43), which are 5 ft. $11\frac{1}{4}$ in. long by 6 in. wide at the bottom, shaped out to 5 in. wide above the seat by 1 in. thick. The stiles are connected by a top rail B, which is 2 ft. 2 in. long by 3 in. deep by 1 in. thick; lower rail C, 2 ft. 2 in. long by 4 in. deep by 1 in. thick; and a bottom rail D, 2 ft. 2 in. long by 2 in. deep by 1 in. thick. The rails are mortised and tenoned into the stiles, the joints being arranged as shown. The bottom edges of the tenons on the top rail, both edges of the tenons on the lower rail, and the top edges of the tenons on the bottom rail should be haunched down $\frac{1}{4}$ in., to allow for the depth of the rebates for the mirror and the grooves for the panels. The space between the stiles and the lower and

Fig. 41.

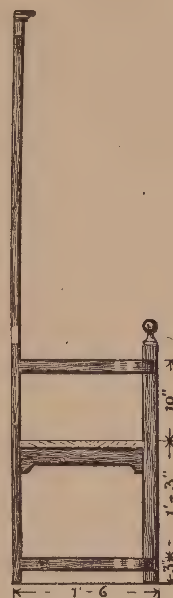


Fig. 42.

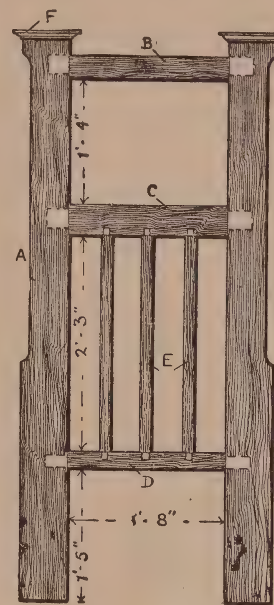


Fig. 43.

Figs. 41, 42 and 43.—Front, Side and Back Elevations of Hall Stand and Seat

Fig. 44.—Detail of Panelling

Fig. 46.—Detail of Caps

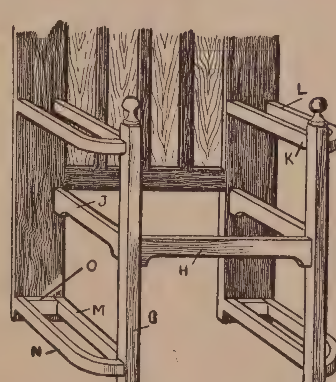


Fig. 47.—Details of Construction of Lower Part

Fig. 45.—Detail of Rebating for Mirror

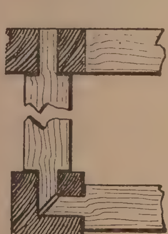


Fig. 49.—Details of Leg Rails

Fig. 48.—Top of Seat Leg

Fig. 50.—Detail of Umbrella Stands

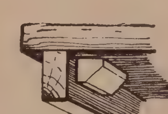


Fig. 51.—Detail of Seat Board

bottom rails is panelled, the panelling being divided by the small upright rails E, which are 2 ft. 5 in. long by $1\frac{1}{2}$ in. wide by 1 in. thick, and are tenoned into the lower and bottom rails, as shown in Fig. 43. The panels should be $\frac{3}{8}$ in. thick, being grooved $\frac{1}{4}$ in. into the edges of the framework, as shown in Fig. 44.

The edges of the framework round the opening for the mirror are rebated $\frac{3}{4}$ in. by $\frac{1}{4}$ in. to receive the mirror, as shown in Fig. 45. The top ends of the stiles are finished with moulded caps F, which are $8\frac{1}{2}$ in. long by $2\frac{1}{4}$ in. wide by 1 in. thick. The front and end edges of the caps are moulded, and the caps are mortised and tenoned to the top ends of stiles, as in Fig. 48. The legs G (Fig. 47) of the seat are 2 ft. 9 in. long by $1\frac{1}{2}$ in. square, and the top ends are turned to the shape shown in Fig. 48. They are framed together by the front leg rail H, and are connected to the back framework by the side leg rails J. The front leg rail is 1 ft. 10 in. long, and the side leg rails are 1 ft. $5\frac{1}{2}$ in. long by 3 in. deep, shaped out to 2 in. deep in the middle by 1 in. thick. The leg rails are mortised and tenoned into the legs, as shown in Fig. 49, the ends of the tenons being mitred together, and the side leg rails are tenoned into the back framework as shown.

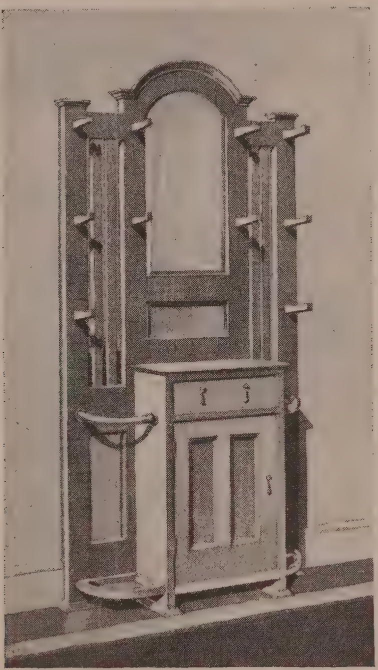


Fig. 52.—Hat and Umbrella Stand

The stick and umbrella stands at the sides are formed by connecting the top ends of the legs to the back with a straight rail K and a shaped rail L, the sticks and umbrellas being placed in the space between the rails. The rails are each $1\frac{1}{2}$ in. deep by 1 in. wide in section, and they are framed into the back and into the legs, as shown in Fig. 50. Metal drip pans are fitted at the bottom of the stands, and the framework into which they fit consists of a straight rail M, an outer shaped rail N, and a filling piece O. The rails are similar to those at the top of the legs, and are fixed in a similar manner. The filling piece O is of a similar section to the rails, and it simply fits between the rails, being secured to the back of the stand.

The seat board is 1 ft. 11 in. long by 1 ft. 5 in. wide by 1 in. thick; it fits over the legs and rests on the leg rails, to which it is secured with wood glue blocks, as shown in Fig. 51, while screws are driven through the back of the stand into the back edge of the seat. The mirror, which is fitted to the back of the stand, fits into the rebates prepared for its reception, and is fixed with small fillet pieces, as shown in Fig. 45, while a thin protective wood back is screwed on behind the mirror.

HAT AND UMBRELLA STAND

The hat and umbrella stand shown by Fig. 52 has two parts, the upright frame at the back, and a cupboard and drawer in front. These two parts are connected by curved rods for holding umbrellas, and also by means of boards at the bottom, as shown at A (Figs. 53, 54 and 55). Other details of construction are shown in Figs. 56, 57 and 58.

To construct the stand, begin with the back framework, as in Fig. 58. This consists of 1-in. framing forming seven panels

of varying sizes as shown, and tenoned where indicated by dotted lines. Plane up the wood to the correct width and thickness, and saw to length, allowing 1 in. more for the main uprights to ensure firm mortises, this spare inch being sawn off after the rails are glued in. Cut the requisite mortises and tenons, and put all together and see that every joint is good. In order to get neat and close joints the tenons should be marked with a chisel held obliquely, and run along the blade of the square before sawing off. The central panel (B) has a segmental head, set out as in Fig. 59, and necessitating a certain amount of cutting to waste. This is to receive a bevelled mirror, so the inner edges must be

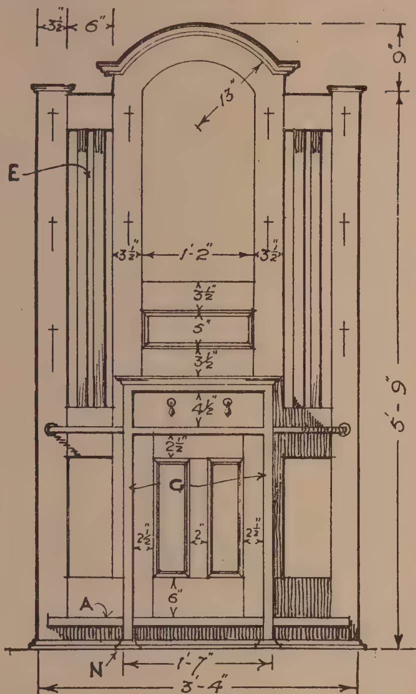


Fig. 53.

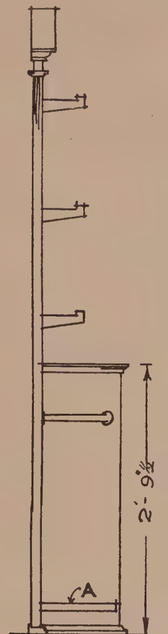


Fig. 54.

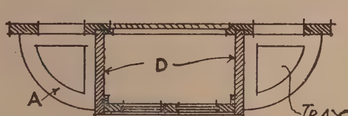


Fig. 55.

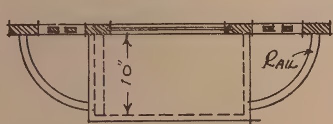
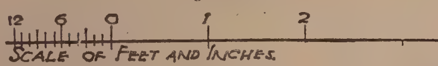


Fig. 56.



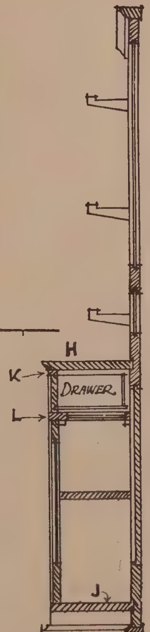


Fig. 57.

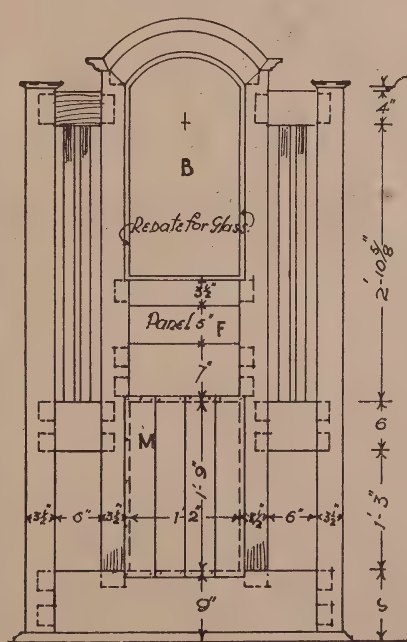


Fig. 58.

Figs. 53 and 54.—Front and Side Elevations of Hat and Umbrella Stand
Fig. 55.—Plan of Lower Part
Fig. 56.—Plan of Upper Part
Fig. 57.—Vertical Section
Fig. 58.—Back Elevation

rebated, as shown at C in the same figure. The framework must be grooved to receive the bottom boards A (Fig. 53, etc.) and the sides of the cupboard D (Fig. 55). When all are cut and fitted glue up the whole, adding four $1\frac{1}{2}$-in. by $\frac{5}{8}$-in. laths as at E in Figs. 53 and 59, and a panel under the mirror space F (Fig. 58), and cramp up.

Now prepare the box, etc., in 1-in. stuff. It consists of solid sides G (Fig. 53), bottom and moulded top H and J (Fig. 57), a rail $1\frac{1}{4}$ in. wide and one 2 in. wide K and L, a panelled door, and an ordinary drawer with runners, as well as a shelf across the cupboard if required. The whole is housed together and into the back framing, and the small shelves are housed into the upright sides. The cupboard back is filled with tongued boarding let into rebates, as at M in Fig. 58. The whole is finished by the addition of moulded cappings (Fig. 60), and a rebated and chamfered base to the back (Fig. 61), mitreing with a grooved and chamfered base to the cupboard sides, as at N in Fig. 53. The boards A for the bottom should be rounded as shown, and hollows sunk $\frac{3}{4}$ in. to receive pans for drips. The curved brass or oxidised tube may be obtained from an ironmonger, together with rings or plates to cover its junctions with the woodwork. A pattern drawn full-size should be supplied. Let the centre of the curved tube be drawn from a 9-in. radius, and allow $\frac{3}{4}$ in. at each end beyond the quadrant for insertion. Drive the brass rail into the front legs, and cramp up the cupboard, etc., with the back frame and bottom boards. Secure the bottom board to the back and the box to the rails, with screws from the back.

The mirror should be fixed by means of wedges, as at C in Fig. 59, the back board being kept quite clear of it.

Brass or oxidised hooks may be screwed on; or these can very suitably be formed in wood as shown, tenoned right through the framing, and wedged from the back. Cut a paper pattern of the sunk hollows in the bottom board, and get an ironmonger to make two zinc trays 1 in. high, with a beading on the tops, and the stand is complete.

HALL SEAT IN OAK

The introduction of lobby halls in even comparatively small houses has provided greater scope for hall furniture than has hitherto prevailed in the long passages of the older houses. In the latter, opportunities were exhausted after a hall stand and chairs, with perhaps a small narrow table, were introduced. Perhaps the most decorative piece of furniture in an old-fashioned hall is a good grandfather clock, and next to this must be placed the hall settle. Its value as a decorative piece of furniture will be generally admitted, and if it is provided with a hinged lift-up seat, its usefulness is increased, and one has both seat and chest. In some cases the peculiar plan of a hall is such as to favour the introduction of a fitted hall seat, and in this connection it may be noted that with but little variation the design shown by Fig. 62 could be modified to suit the changed conditions. In the case of a recess, it is a good plan to have a panelled back, and also panelled instead of shaped sides, such as are illustrated. Figs. 63 and 64 are front and end elevations, and a vertical section is given by Fig. 65. Two views of the back are shown by Fig. 66.

When constructing the settle the ends should first be jointed up with dowelled joints, so that two ends can be cut from one piece. The best plan is to first cut a piece of stiff brown paper exactly the shape of one end to form a template. It is then an easy matter to obtain the necessary size for jointing the wood sufficient to cut one in the other as indicated by Fig. 67. After jointing, the wood should be levelled on both sides, and the shapes marked out by means of the brown-paper template. To shape the ends they should be hand-screwed together and both planed, spokeshaved, filed, and glasspapered in turn, the bottoms being sawn and planed true and square. By practising this method both ends are obtained exactly alike and with the edges square and sharp. Should they be made separ-

ately there is always the risk of variation, which may cause the settle to "wind" when glued up. It is, of course, also an additional advantage to have the edges perfectly square and sharp in the first instance.

The chief part of the settle is the back, and, as will be seen from Fig. 68, the top or cap moulding D is made separately, and dowelled on to the back frame. The back is made with six panels, and should preferably be mortised and tenoned together. It will be necessary to make the outside stiles wider than the muntins, as the back screws into rebates made in the ends. This detail is indicated in Fig. 69. It is advantageous to bevel the rebate as shown, as by this means the remaining part of the end is strengthened, and is less liable to break away than is the case when the rebate is made square with a resultant narrow slip remaining on the end.

The moulded edge to the stiles and rails, shown in Fig. 68, should properly be worked with a scratch-stock, the ends "running out," which necessitates carving with gouges to finish the mouldings. A pleasing character is given to the work by this particular detail; but alternately an ovolo could well be used, which would be run through the muntin and scratched at intervals on the stiles and rails. The correct finish to a moulding of this type is, of course, the mason's mitre, which again gives more character to an oak job than ordinary mitreing. It will be seen that the panels are placed in position before the frame is glued up, and when the latter has been effected the back frame can be levelled on both sides and squared up. The front frame is made on similar lines to the back, and then the seat and frame can be proceeded with.

The plan (Fig. 70) shows a three-sided seat frame which is mortised and tenoned together to receive a hinged lid or seat. The latter is cut from solid stuff, and then the ends are clamped to ensure flatness. A curve is introduced at the front, and, as will be seen, it projects at the front and facilitates opening the lid. An enlarged detail (*see* Fig. 71) indicates the correct position of the hinges. When fitting these, a marked gauge should be set from the edge of the hinge to the centre of the knuckle. This is used on the edges, and the thickness of one wing is then gauged on the seat and rail. The bottom is made either of solid oak or American whitewood faced up with American oak.

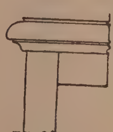


Fig. 60.—Moulded Top to Cupboard

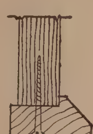
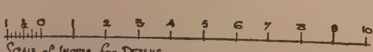


Fig. 61.—Detail of Base and Back



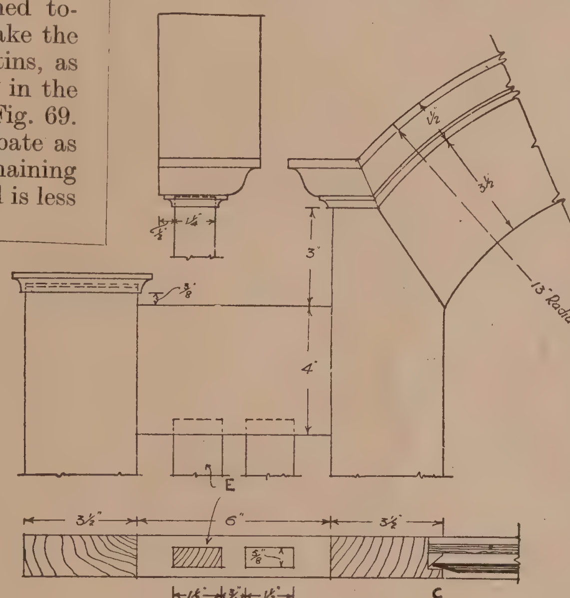


Fig. 59.—Enlarged Details of Top

After the back seat, front, and bottom have been properly marked, they can be squared up to their finished sizes and prepared for attachment to the ends. The seat frame should first be dowelled into the ends (Fig. 72), then the front frame should be dealt with likewise, and finally the bottoms ; $\frac{3}{8}$-in. dowels should be used, and care should be taken to bore and fit carefully in order to make a strong, rigid seat. When the parts have been glued together the seat frame is screwed from the back, and the bottom is screwed up to the front frame. To further strengthen the job, neat angle-blocks should be glued in the angles underneath the seat and also underneath the bottom.

A most important part of cabinet-work is the finish imparted to the work. Should English or European oak be used, fuming and waxing can be employed to advantage.

OLD-STYLE SETTLE

Hooded seats or settles such as that illustrated by Fig. 73 are still to be found in old farmhouses and inns. They are essentially picturesque, and well adapted for use in a hall. To be appropriate in appearance, modern replicas should be quite simple in design, but of fairly heavy construction. The ideal material of which to construct it would be oak ; but selected pine treated with a water-stain and slightly waxed would be quite suitable. The

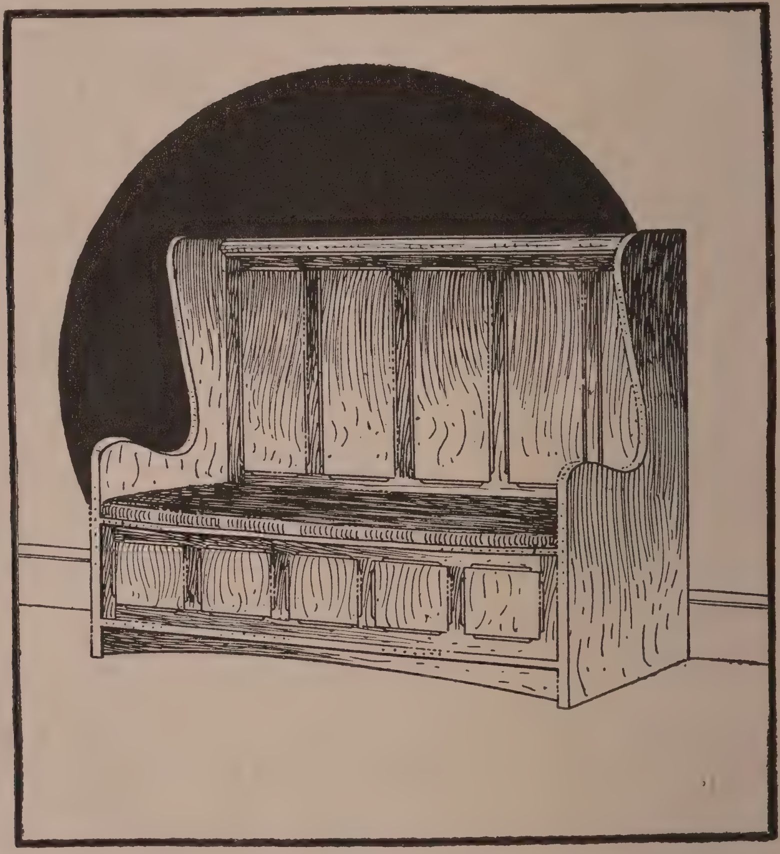


Fig. 62.—Hall Seat in Oak

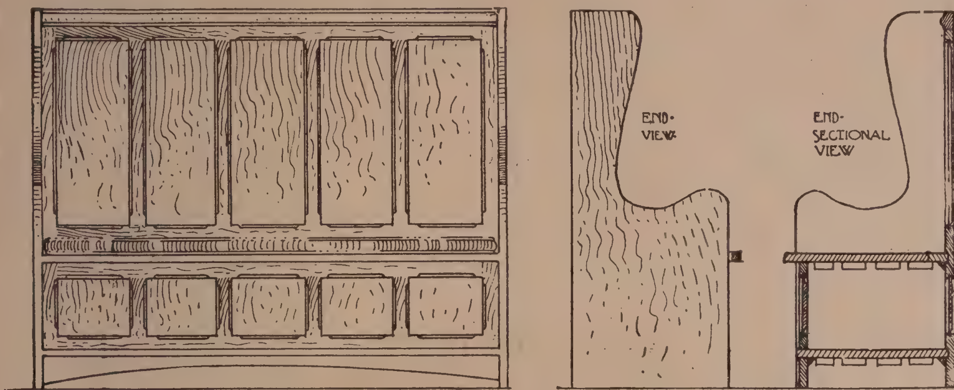


Fig. 63. Fig. 64. Fig. 65.

Figs. 63, 64 and 65.—Front and Side Elevations and Vertical Sections of Hall Seat

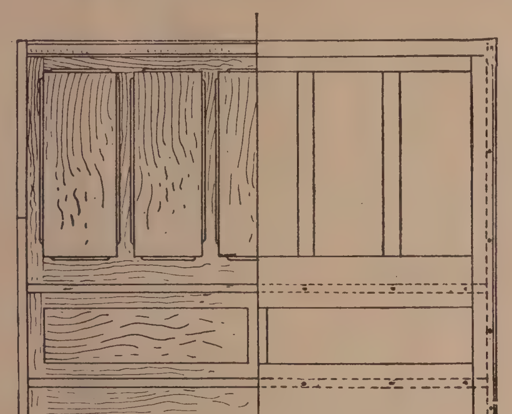


Fig. 66.—Two Half Back Elevations

Fig. 68.—Enlarged Detail of Back

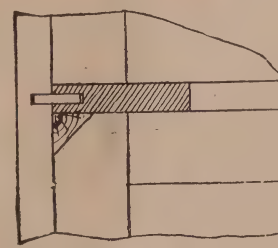


Fig. 72.—Detail of Seat Frame

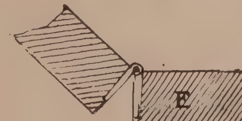


Fig. 71.—Detail of Hinging Seat

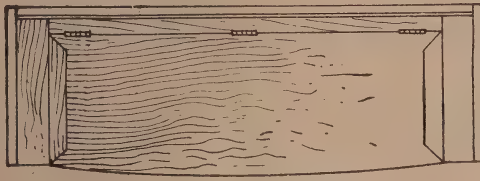


Fig. 70.—Plan of Seat

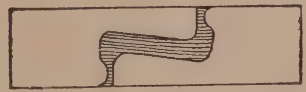


Fig. 67.—Method of Marking Out Ends

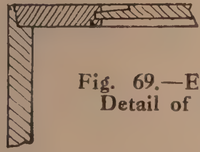
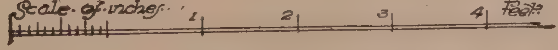


Fig. 69.—Enlarged Detail of Corner



drawers under the seat are useful, although not essential parts of the design.

Front and end elevations and sectional plan are shown by Figs. 74, 75 and 76 respectively.

To begin the work, the ends should be prepared from stuff not less than $1\frac{1}{4}$ in. thick, built up of three widths of about $8\frac{1}{3}$ in. each, tongued together and shaped, as shown in Fig. 75. From this the outline of the back edges can be readily obtained, while the large curve of the front can be enlarged from Fig. 78, by first of all setting out the series of inch squares there given. In the same way the slighter curve below seat level can be obtained from Fig. 79, the series of squares working downwards from the top of the seat, which is 1 ft. 6 in. above the floor at the front. If preferred, the three pieces constituting each end can be dovetail-keyed together with hardwood, as shown in Fig. 75. At the top the ends are connected by means of a 4-in. by 1-in. rail as at A in Fig. 77, dovetailed as at B in Fig. 80, and above this will ultimately be fixed a raking top at least 1 in. thick, moulded all round, as shown in Fig. 80. Into this the ends and rail should be housed or tongued. If this is not done, ledges should be fixed as at D (Fig. 77), to prevent the ends from warping through lack of stiffening.

The seat E (Fig. 77) should also be of substantial thickness, rounded on the front (Fig. 79), and finishing flush with the ends at the back (Fig. 81). It slopes $\frac{3}{4}$ in. towards the back, and should be housed $\frac{1}{4}$ in. into the ends. Under it in the centre is a shaped standard or support F (Figs. 74 and 77), fitted close up to its underside and notched to suit two longitudinal drawer rails shown in Fig. 79, one G $1\frac{1}{2}$ in. by $\frac{3}{4}$ in., and the other H 2 in. by 1 in., both being housed into the ends. The lower part of the work is stiffened by means of a $2\frac{1}{2}$-in. by $1\frac{1}{2}$-in. tie J (Figs. 74, 76 and 77) taken completely through the ends and central standard, and rounded, mortised, and wedged, as in Fig. 82. Drawer divisions or guides should be fitted

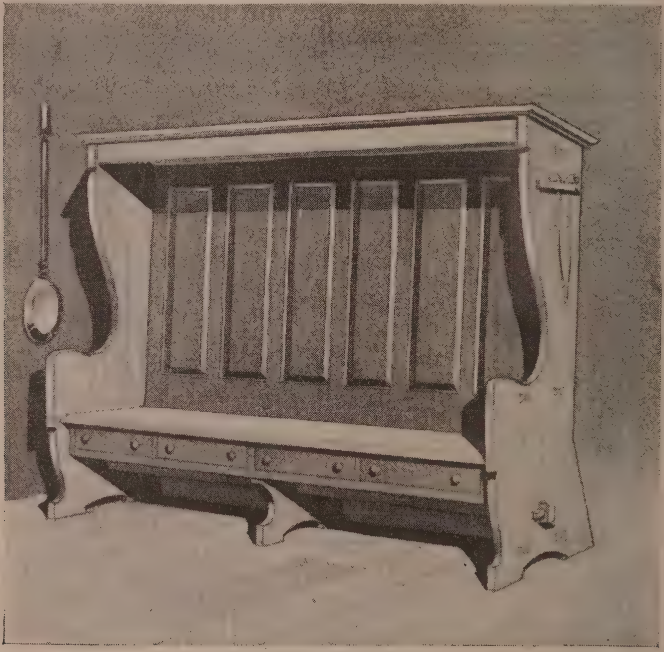


Fig. 73.—Old-style Settle

from front to back, as at K in Figs. 74 and 76, and drawer-runners as in Fig. 79 screwed on.

Below the seat, the back is filled in with $\frac{3}{4}$-in. panelled framing in three long divisions, its top fixed against a fillet, as at L in Fig. 81, while above is a piece of stout 1-in. panelling, having square edges to the framing, but with the panels moulded on the front, as in Figs. 74 and 82, a moulded fillet as noted in the latter figure being planted on the horizontal edges only of all the back panels. This framing should be housed to the ends, seat, and top, or tongued as in Figs. 80, 81 and 82.

Alternatively the back might be filled in with boarding having ploughed edges joined up with very wide tongues (leaving, say, 1 in. between the boards), this necessitating a ledge or rail across the top and bottom. It will be found advisable to cut the central standard slightly shorter than the ends, in order to obviate any possibility of the settle rocking on it.

SIMPLE LOBBY GLASS WITH COAT HOOKS

In many modern houses of the smaller type, the entrance passages or lobbies are so narrow that to place a hall stand in such a contracted space is almost impossible. Yet it is desirable to have something on which to hang hats, coats, etc. A mirror is also almost indispensable.

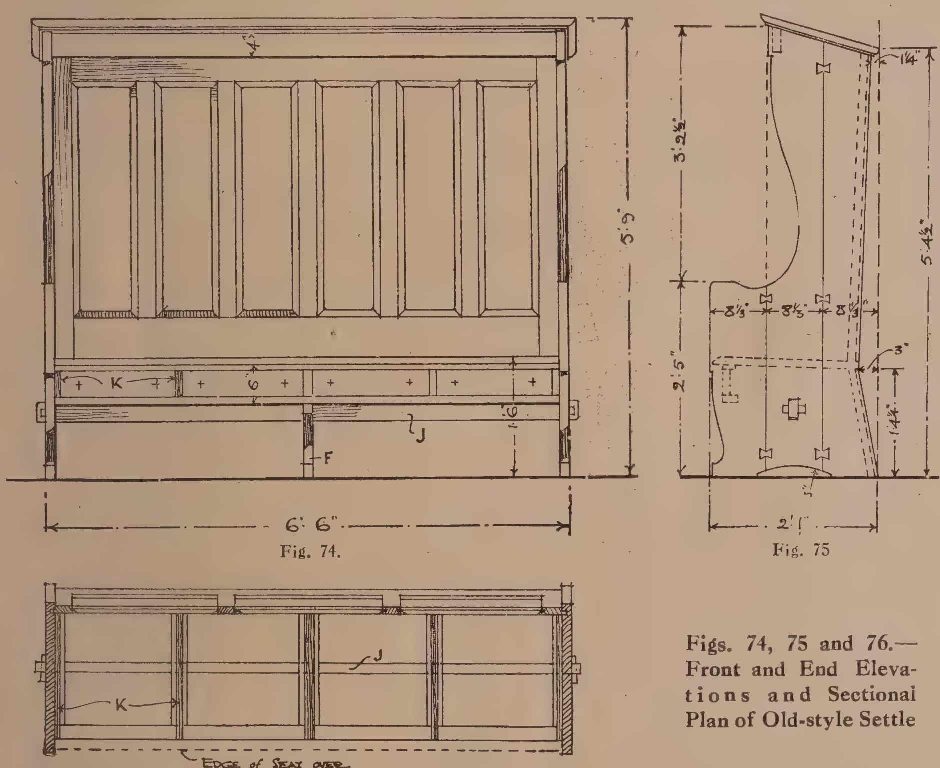


Fig. 74.

Fig. 75

Fig. 76.

Figs. 74, 75 and 76.—Front and End Elevations and Sectional Plan of Old-style Settle

The hat and coat rack shown by Fig. 83 is designed to take up as little room as possible, and if a small umbrella stand is placed underneath, it will be found much more convenient than the orthodox

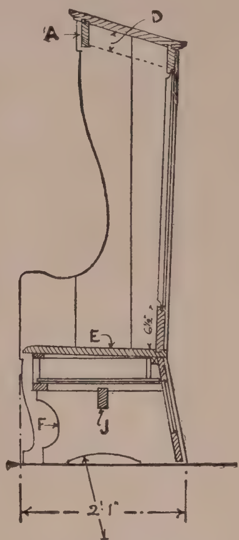


Fig 77.—Vertical Section of Old-style Settle

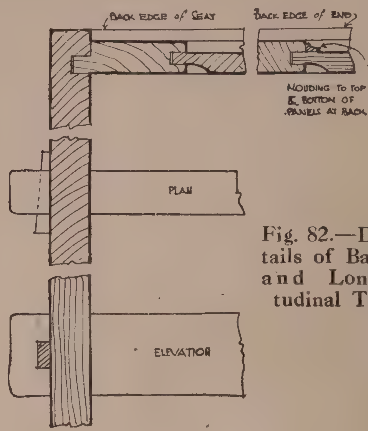
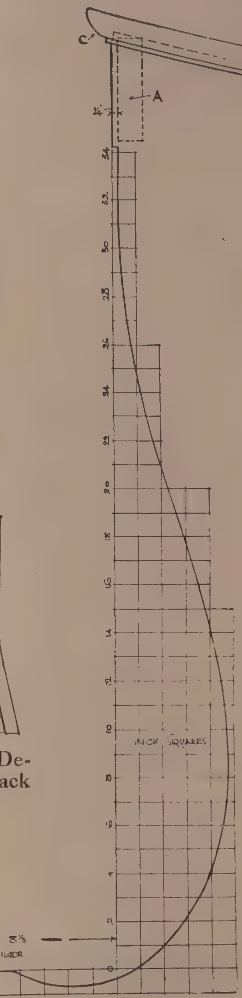


Fig. 82.—Details of Back and Longitudinal Tie



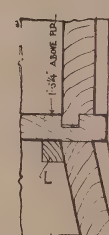


Fig. 81.—Detail of Back of Seat

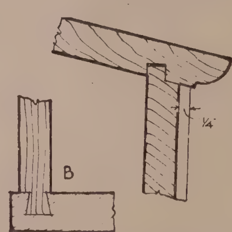


Fig 80.—Details of End and Top

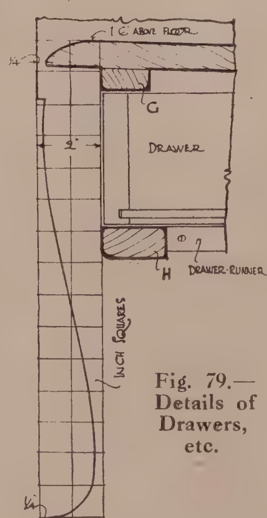


Fig. 79.—Details of Drawers, etc.

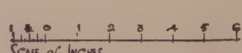


Fig. 78.—Detail of Large Curve to Ends

hall stand. An end elevation and cross sectional plan are shown by Figs. 84 and 85.

In selecting the wood, oak is undoubtedly the most appropriate; but canary, or even any of the softwoods, painted white would look very well. If oak is used, it should be stained dark and french-polished or carefully varnished. The construction has been kept as simple as possible, so that anyone with the least elementary knowledge of woodwork can start on the work with the fullest confidence of success. All dimensions and details of construction are given by Figs. 86, 87 and 88.

The frame is made out of wood of the same section, all the joints being simple half-laps, as shown by the dotted lines. The cut pieces and laths fit into notches cut for them in the rails. The centre-piece in the panels can be cut out of a piece of wood of the same section as that for the frame, by sawing a piece of the required length down the centre, thus forming two pieces ready for cutting into

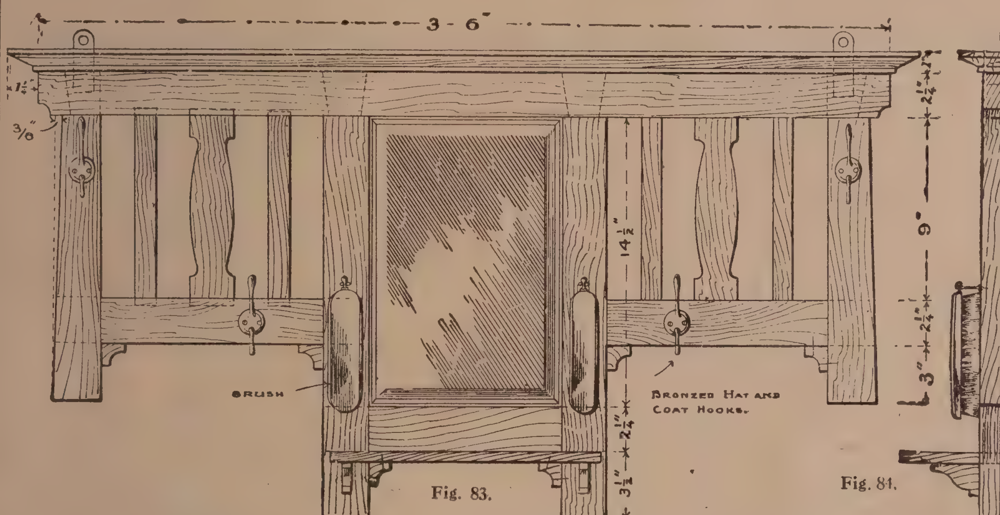


Fig. 83. Fig. 84.

Figs. 83 and 84.—Front and End Elevations of Lobby Glass

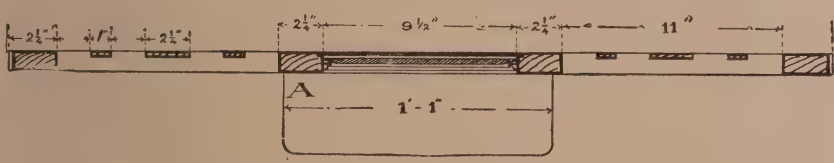


Fig. 85.—Cross Sectional Plan

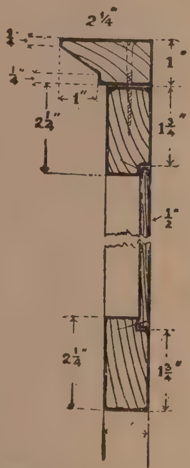


Fig. 86.—Enlarged Vertical Section through Framework

Fig. 87.—Detail Plan at A (Fig. 85)

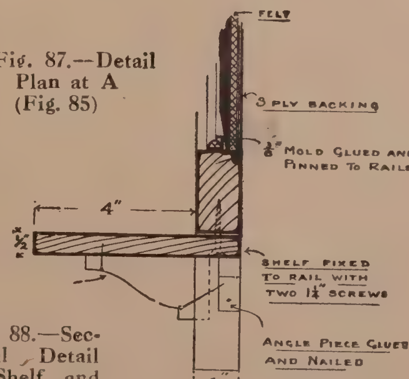


Fig. 88.—Sectional Detail of Shelf and Mirror Fixing

shape with the fret-saw or spokeshave. A small moulding is planted on round the opening in the centre to receive the mirror. This moulding could be run on the frame by those who are a little more experienced in the work. In forming the cornice, having cut the wood to the required length and squared it on all faces, set the stop of the rebate plane to make a rebate 1 in. wide, and the depth stop set to make the rebate $\frac{1}{4}$ in. deep. When the rebate is formed take off the width stop, but retain the depth gauge; and after adjusting the plane iron so that no more wood can be removed from the shoulder of the rebate, proceed to form the slope of the cornice by planing away the wood until $\frac{1}{4}$ in. remains on the face of the outside edge. The returns of the cornice can be easily worked with the aid of a tenon saw and a large chisel.

Two pieces of wood 10 ft. long by $2\frac{1}{4}$ in. wide and 1 in. deep will be sufficient to make all the frame; but a special piece will be required for the shelf and brackets supporting the shelf. About 4 ft. of moulding will be required for planting on round the mirror.

SIMPLE UMBRELLA STAND IN OAK

The general dimensions of the simple umbrella stand shown by Fig. 89 are 2 ft. 6 in. long over the posts by 10 in. deep and 2 ft. 4 in. high from floor to top rail. Front and end elevations and plan are given by Figs. 90, 91 and 92.

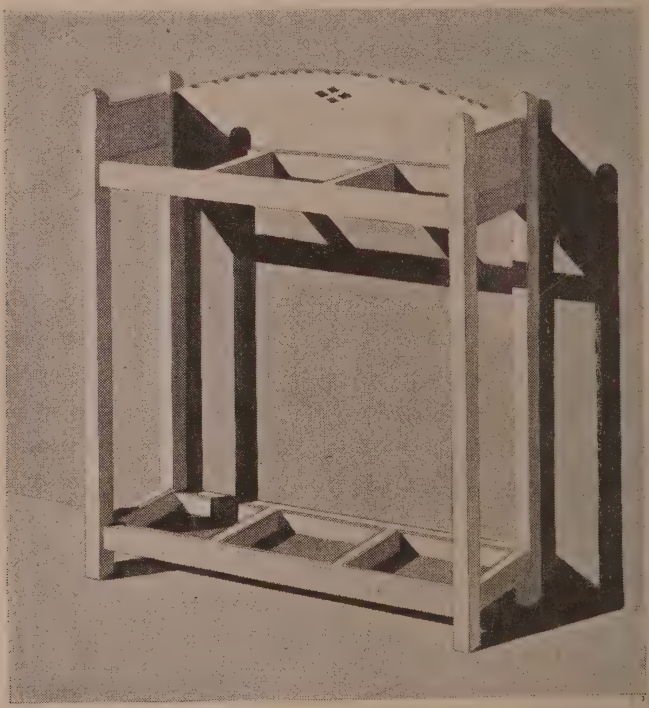


Fig. 89.—Simple Umbrella Stand

To proceed with its construction first prepare the four posts; square them up to $1\frac{1}{4}$ in. by $1\frac{1}{4}$ in. and mortise for the top and bottom rails, which are $1\frac{3}{4}$ in. by $\frac{7}{8}$ in. and 2 in. by $\frac{7}{8}$ in. respectively. Tenon the rails to the posts (*see* Fig. 93), keeping the latter $\frac{1}{8}$ in. in advance of the rails. Fig. 94 gives a section of the bottom rails which

are 2 in. deep by 1 in. thick, and are rebated to receive the ½-in. pine bottom D, which is fitted and fixed with screws to the bottom rails. The cross-rails 1¾ in. deep by ⅞ in. thick are stub-tenoned to the long rails at top and bottom. Between the posts above the top rails are fitted a shaped back and two side pieces (*see* Figs. 90 and 91). These are of ½-in. material and are housed into the posts. The tops of the latter are shaped and chamfered, as shown in Fig. 95, while the shaped back is decorated by means of a chamfered pattern along its upper edge (*see* Fig. 90). The diamond shaped decoration at B may either be pierced or may be inlaid with ebony. A detail of this is given by Fig. 96.

The zinc pans fit between the bottom rails, as shown in Fig. 94.

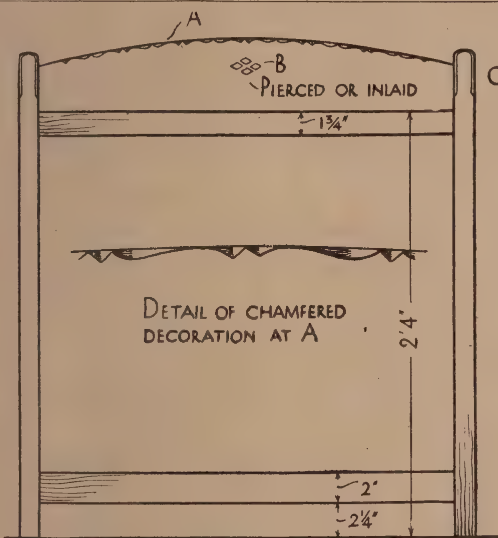


Fig. 90.

Fig. 91.

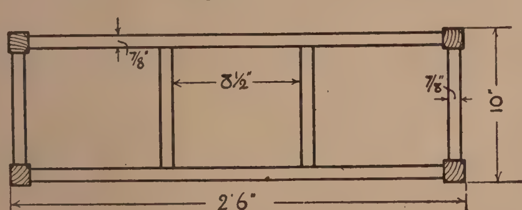


Fig. 92.

Figs. 90, 91 and 92.—Front and End Elevations and Plan of Umbrella Stand

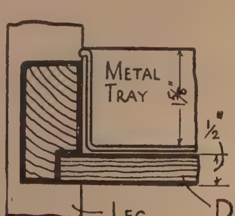


Fig. 94.—Section of Bottom Rail

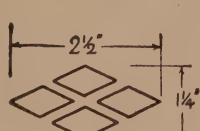


Fig. 96.—Detail of Ornament

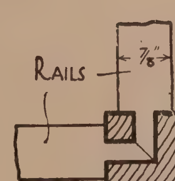


Fig. 93.—Detail of Joint between Rails and Leg

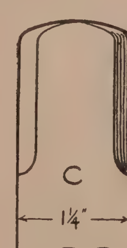


Fig. 95.—Shaping at Top of Posts at C (Fig. 90)

Dressers and Sideboards

MODERN KITCHEN CABINET OR DRESSER

A CABINET useful for kitchen or living room, and designed to hold all necessary utensils and materials for preparing food, is shown by Fig. 1. It occupies very little space while affording the maximum amount of accommodation. It could be placed with ease in the recess formed at the side of a fireplace.

The lower portion is divided up into

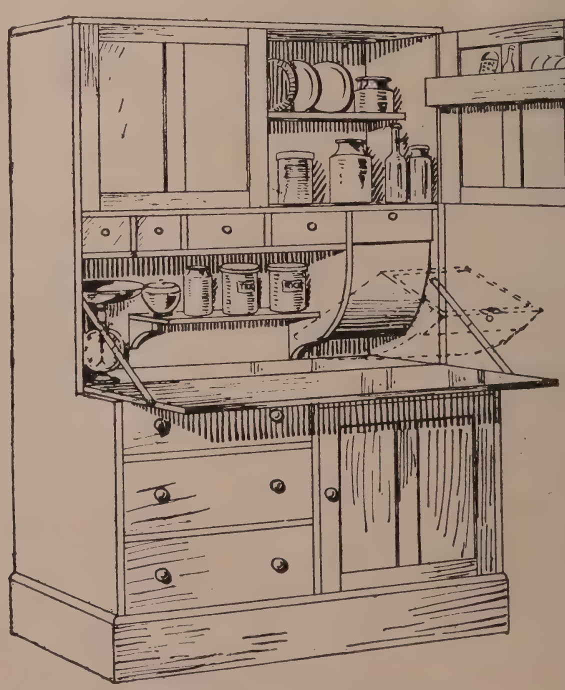


Fig. 1.—Modern Kitchen Cabinet

three drawers on the left side, the top one being for cutlery, and divided into three divisions and lined with green baize. On the right-hand side is a cupboard with shelf for storing pots and pans; the pastry-board slides in a recess above the door. The upper part, enclosed by a hinged flap, contains two small and two large drawers for spices and such commodities as are used in cooking. On the right-hand side is a flour bin pivoted at the bottom, and kept in position when closed by a strong snap-catch. This bin when in use is lowered until it rests on the open flap and permits of easy access for removing the flour. Below the drawers is a small shelf for tins, etc., and on the left is space for a weighing machine. Above is another cupboard with shelf enclosed by two doors. On the doors are fixed two wooden trays for small articles. The shelf has a raised fillet to keep plates from slipping when standing on edge. The constructional work is of the simplest order, and only a few details need be outlined.

The sides should be $1\frac{1}{8}$ in. thick, tongued and grooved to the $\frac{7}{8}$-in. thick top. The drawer and door rails and bearers are $2\frac{1}{4}$ in. by $\frac{7}{8}$ in., and housed into the sides. The doors are framed up with $2\frac{1}{4}$-in. by $\frac{7}{8}$-in. stiles and rails, and the panel-fillings of $\frac{5}{8}$ in. are tongued and grooved into framing. The drawers have $\frac{7}{8}$-in. fronts, lap-dovetailed to the $\frac{3}{8}$-in. sides. A plinth, $\frac{7}{8}$ in. thick, is tongued under the bottom bearer. A study of the scale drawings (Figs. 2 and 3) will render these instructions clear.

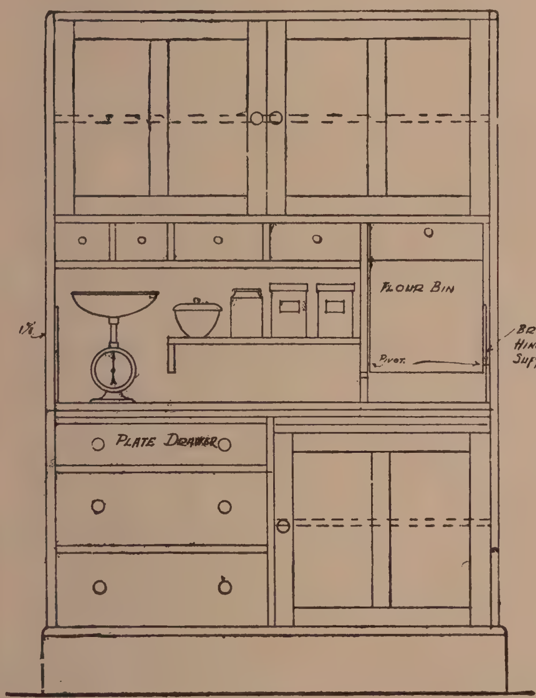


Fig. 2.

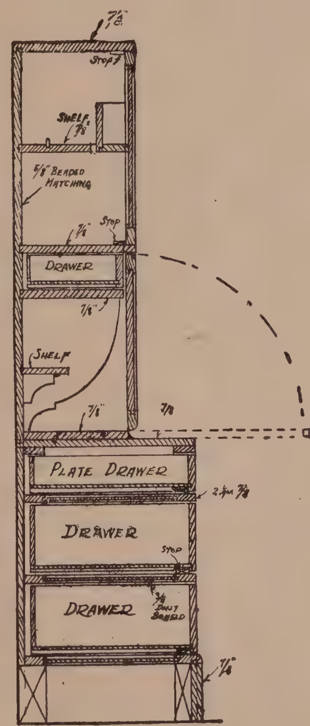


Fig. 3.

Figs. 2 and 3.—Front Elevation and Vertical Section of Modern Kitchen Cabinet

The general woodwork is deal, painted

white, the flap of teak and unpainted inside.

KITCHEN DRESSER WITH ENCLOSED MANGLE

In many small cottage homes a mangle is a necessity, but, as a rule, not an ornament, and the dresser shown by Fig. 4 has been designed to cover it whilst not in use. It will be understood that the mangle is

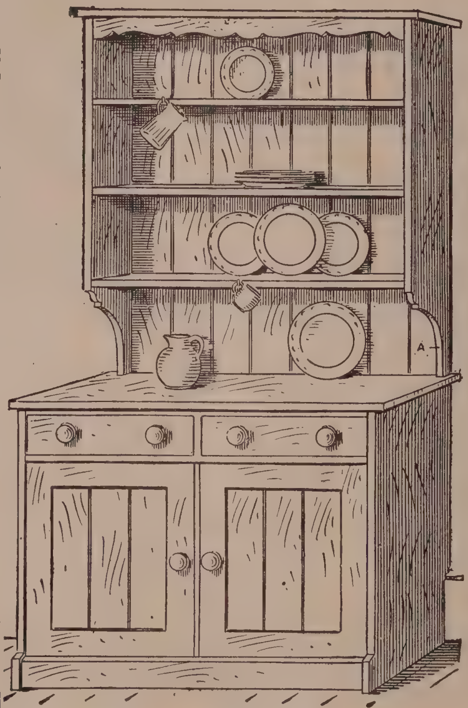


Fig. 4.—Kitchen Dresser with Enclosed Mangle

by nature of an accessory, and that with a little modification the dresser could be utilised for other purposes. Mangles are usually obtainable locally, and the general dimensions of them when folded are: Height from floor to top, 2 ft. 3½ in.; length of top, 3 ft. ½ in.; and 1 ft. 8½ in. wide. Should there be any variation from these sizes due allowance would have to be made. Part front elevation and end elevation are shown by Figs. 5 and 6.

The upper part of the dresser, with shelves, is separate from the lower part, and is fixed with holdfasts and screws to the wall, the latter being drilled and plugged to receive the iron holdfasts. The lower part of the dresser (Figs. 7 and 8) is made with the ends to fold inwards against the front, which is made to imitate doors and drawers. Thus, when not in use it can be placed flat against a wall. The front and ends are kept in position by iron stays. The loose top simply rests on the front and ends. The height of the dresser top is about 8 in. higher than the mangle top, so that, if desired, any articles may be placed out of sight by simply raising the front edge of the top. The hollowing out of the lower ends of the upper part A in the end elevation (Figs. 4 and 6) allows for the handle of the mangle to turn.

The complete dresser may be made of pine or deal, painted or stained to match walnut or mahogany. The main dimensions are: Total height, 6 ft. 9 in.; height of lower part, 3 ft.; and extreme width across the front, 4 ft. The back of the upper part B in the part front elevation (Fig. 5) and the sham door panels are made of ½-in. matchboarding, and the remaining parts of 1-in. stuff, finishing when planed about ¾ in. full. The trouble of planing the wood may be avoided by purchasing good sound flooring boards and jointing them to the requisite widths. Most local timber merchants keep these in stock.

In making the dresser the top part with shelves may be first taken in hand. The ends have a rebate worked in the back edges to receive the matchboarded back. The shelves, of course, will be the thickness of the back, less in width than the ends. The latter must be dovetailed grooved across to receive the ends of shelves (Fig. 9). The groove in the ends must be stopped ¼ in. from the front edge, so that the dovetail will not show at the front. The top C (Fig. 5) may be grooved likewise to receive the top parts of the ends.

When the top, shelves, and ends are fixed with glue and nails, next fit in the matchboarding back B. This may pass down behind the top of the lower part. When fixing to the wall due regard must be paid to the weight of crockery it will be likely to contain. The front of the lower part, from the floor to the top. The double centre stile is tenoned into the top and bottom rails F and G. A plinth H, $\frac{3}{4}$ in. thick, with bevelled top edge, is planted on the bottom rail G. The imitation bearers J are strips about $\frac{1}{8}$ in. thick and $\frac{7}{8}$ in. wide, and are planted on the face of

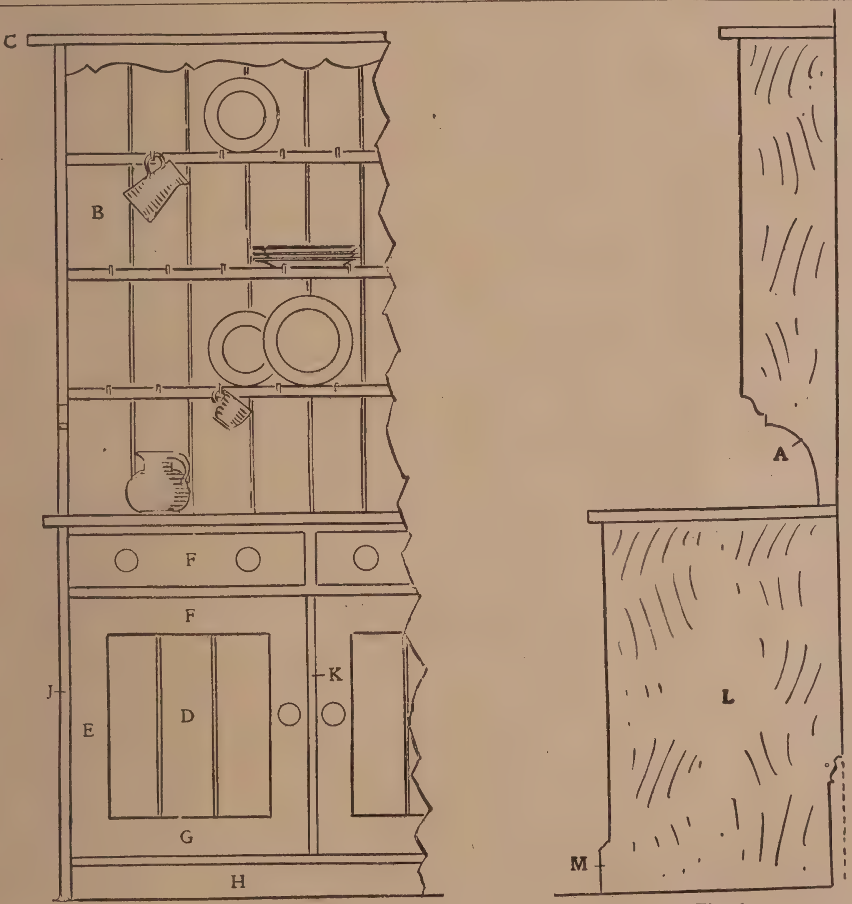


Fig. 5. Fig. 6.

Figs. 5 and 6.—Part Front Elevation and End Elevation of Dresser enclosing Mangle

in imitation of doors and drawers, should be framed together with mortises and tenons, grooves being ploughed in the stiles and rails to receive the panels D (Fig. 5). The two outer stiles E extend the framing and secured with glue and brads; likewise K, about $\frac{3}{8}$ in. wide, $\frac{1}{2}$ in. round in section. The ends L have a piece M glued on the front edge, so that the plinth H can butt against them. The

ends L (Fig. 6) are fixed to the front framing with hinges, as shown by Fig. 10. The iron angle stay (Fig. 11) may be made of stout wire, or, better still, by a smith, of $\frac{1}{4}$-in. iron rod, and connected to the front and ends with iron screw eyelets, which can be had from most ironmongers. Four blocks O, or two battens about 2 in. wide, should be fixed to the underside of the top, as shown in Fig. 12. These will keep the top in the proper position. The dresser may be made 3 in. or 6 in. narrower or wider if desired. Knobs as shown (Fig. 13) may be used, or brass handles. Hooks

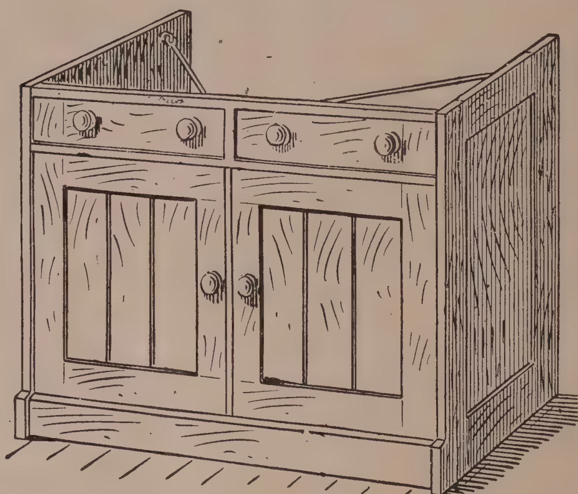


Fig. 7.—Lower Framing and Ends

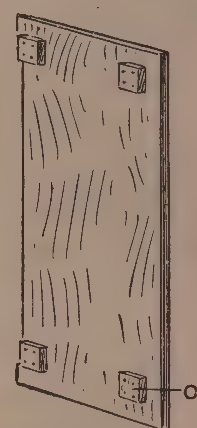


Fig. 12.—Underside of Top

Fig. 9.—Method of Fixing Shelves

Fig. 13.—Dummy Knob

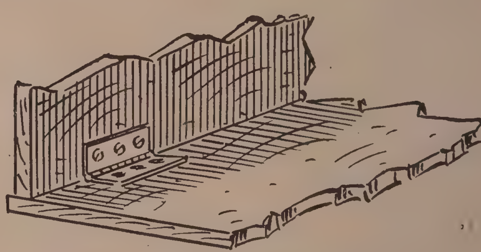


Fig. 10.—Hinging Front Framework to Ends

Fig. 11.—Iron Angle Stay

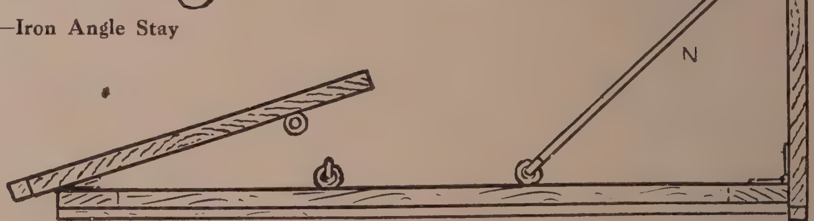


Fig. 8.—Plan of Lower Framing and Ends

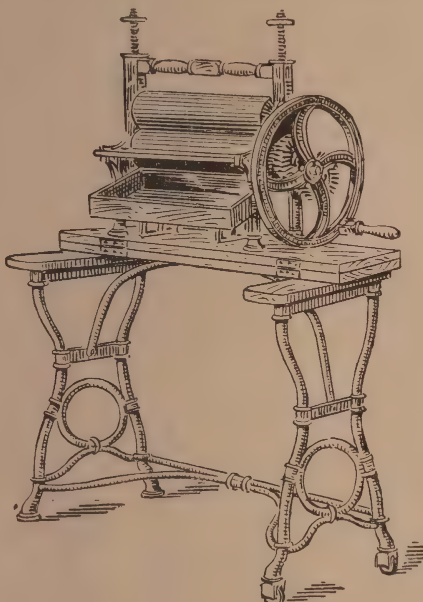


Fig. 14.—Mangle Raised

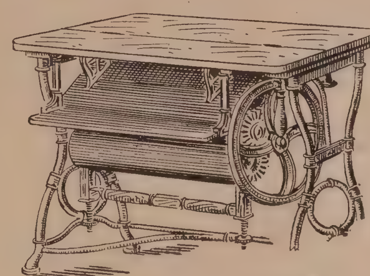


Fig. 15.—Mangle Lowered

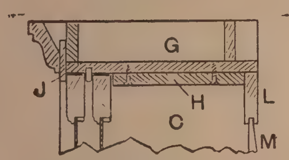


Fig. 19.—Section through Top Portion of Cupboard

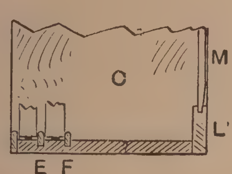


Fig. 18.—Section through Lower Portion of Cupboard

can be fixed to the front of the shelves according to requirements. If the ends of the lower part are panelled they will be less liable to warp than if made in one piece. Two illustrations of a suitable mangle are shown by Figs. 14 and 15.

KITCHEN DRESSER WITH GLASS DOORS

Fig. 16 is a front elevation and Fig. 17 an end elevation, drawn to the scale of feet and inches. The extreme height is 7 ft., and the width outside the carcase ends is 4 ft., the top A projecting 1 in. at the front, back, and ends, and the plinth B $\frac{3}{4}$ in. at the front and ends. The depth of the top carcase C is 1 ft., and the lower carcase D 1 ft. 6 in.; but these sizes may

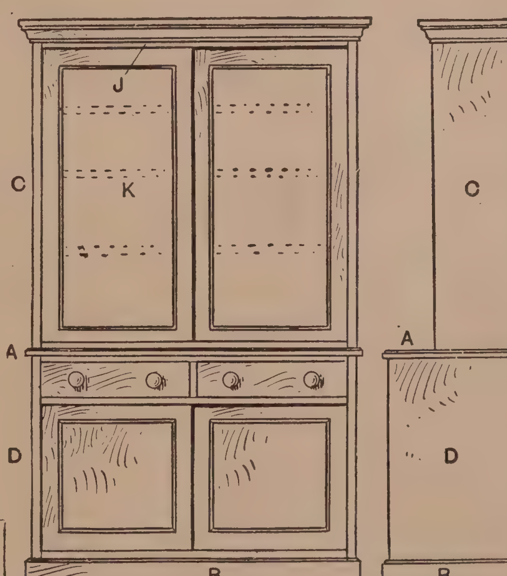


Fig. 16. Fig. 17.

Figs. 16 and 17.—Front and End Elevations of Kitchen Dresser with Glass Doors

be increased or diminished according to requirements, remembering that one door has to pass behind the other. To keep the doors in their right track, grooves E and F (Fig. 18) are ploughed in the bottom of the top carcase, and hardwood strips are inserted as shown. For the top of the doors a similar groove and strip are provided in the detachable cornice G (Fig. 19). The back of the inner door slides against the edge of the carcase top H, and the shelves are fixtures, then matchboarding running from the top to the bottom will serve. In constructing the lower carcase (Figs. 16 and 17) the plinth B is detachable like the cornice, and the doors are pushed up from below and then dropped on the plinth. The fillet E (Fig. 18) coming between the two doors causes a gap extending from the top to the bottom; this must be closed by a strip fixed to the inner side of the front door.

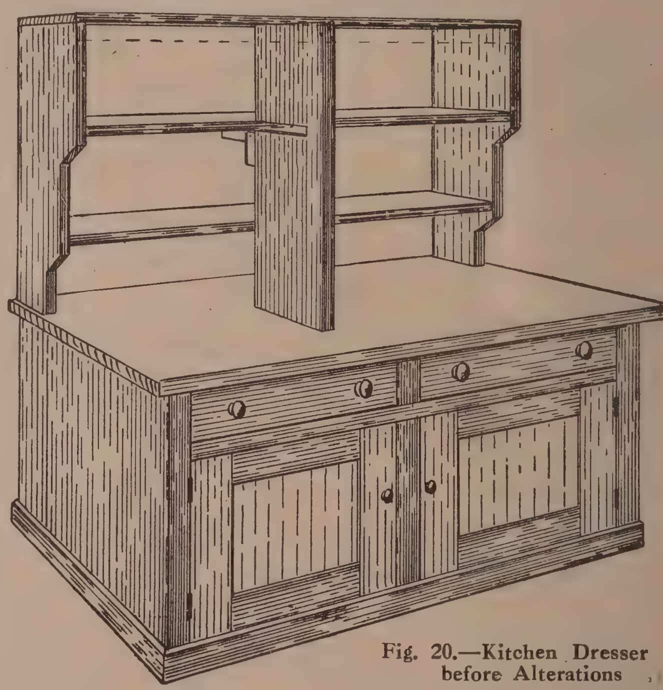


Fig. 20.—Kitchen Dresser before Alterations

front of the outer door against a fillet J (Figs. 16 and 19) fixed behind the cornice moulding. The doors are put in place, and the cornice is dropped over them and then secured with screws from the underside of the top H. If the shelves K are movable like a bookcase, it will be necessary to make the carcase back L (Fig. 19) in one large frame with a centre stile and a cross-rail, with $\frac{1}{2}$-in. thick panels M inserted in ploughed grooves, so as to make the top carcase rigid. But if the

To allow the doors to slide freely, rollers should be fixed to the bottom edges, and to make a substantial job the carcase ends and doors should be about $1\frac{1}{8}$ in. thick.

IMPROVED KITCHEN DRESSER

Utility should be the keynote of modern kitchen furniture, and with this object in mind a design is shown for the conversion of the ordinary kitchen dresser into a real

labour-saving piece of furniture. Fig. 20 shows an ordinary type of kitchen dresser in process of transformation and which, actually (for the purpose it is supposed to fulfil) is more or less useless. The same dresser converted into a really useful article is shown by Fig. 21. It will be noticed that the front of the shelves has been filled with doors, and the shelves widened so that they are deep enough to hold plates flat. The drawers and cupboards underneath are arranged to enable their contents to be reached without trouble, and, above all, the surface for dust collecting is reduced to a minimum. Front and end elevations are given by Figs. 22 and 23.

Fig. 21.—Kitchen Dresser with Alterations Complete

Commencing then with an ordinary dresser, as shown by Fig. 20, first remove all the beading placed on the front of the shelves to keep the plates in place. These pieces should be carefully raised with a flat chisel or a screwdriver to avoid breaking them, for the wood will come in useful in other places. Carefully note where the beading is bradded, and exert most pressure quite close up. Next fit two division boards cut from $\frac{3}{4}$-in. by 11-in. stuff as shown. Slots should be cut in these boards to allow of them being pushed right back to the wall. These slots will require careful marking out, and the best way is to commence with the top slot, as shown at *a* (Fig. 24). The distance to the line should be measured from the shelf, and the position of the groove determined by placing the board quite upright with the edge against the shelf; the thickness may then be marked off. To make sure that the shelf is quite at right angles, place the try-square on as shown in Fig. 20. If there is any inclination, this must be allowed for. The groove should be sawn out close up to the line and

the waste carefully removed. When this groove is done, place the board in position and push the groove on the shelf, so that the second groove may be marked off. Cut this out in the same way, and finally the bottom one, if there is a third shelf, may be marked out and cut. The second division board may be marked off from the first if it fits, and any adjustment may be made. These boards should have a space of 2 ft. if the dresser is a 5-ft. length, used at any rate for the two division pieces. The latter pieces should be 2 ft. apart in the centre, leaving about 1 ft. 2 in. or so for the side openings, as shown by Fig. 25. This frame when placed against the division boards will leave a space at each end, as shown in the side view (Fig. 26); this space has now to be filled up. First of all screw or nail a length of the same material on to the top board of the dresser, as shown at B (Fig. 27), and

Fig. 22. Fig. 23.

Figs. 22 and 23.—Front and End Elevations of Improved Kitchen Dresser

as is usually the case. If longer, a space of 2 ft. 6 in. would do.

The next stage is to make a framework to hold the doors. This should be made from $2\frac{1}{4}$-in. by $1\frac{1}{4}$-in. batten planed down to 2 in. by 1 in. Two lengths will be required for the top and the bottom, these being 2 in. longer than the distance between the uprights holding the shelves. Mortise-and-tenon joints are preferable for the corners, but halving joints may be also another length at the top, as at C. Next cut some lengths to fit between the two uprights, and shape them at the inside ends, with a corresponding sloping notch cut out of the sides. If it is not desired to cut the dresser—and in a rented house this may not be advisable—the pieces should be supported as shown in Fig. 28; but in each case the level of the top of the cross-rails must be on a line with the underside of the existing shelves. The front

frame should be lightly bradded or screwed into position, with the division boards placed exactly in the centre of the division uprights, and then a thin board prepared to fit in the space at each end, as shown in Fig. 29. The boards should be about $\frac{1}{4}$ in. thick, and should fit tightly to allow for inevitable shrinkage.

The whole of the work may now be secured with nails and screws, but it

Fig. 25.—Front Frame to Hold Doors

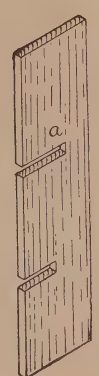


Fig. 24.—Slotted Division Board

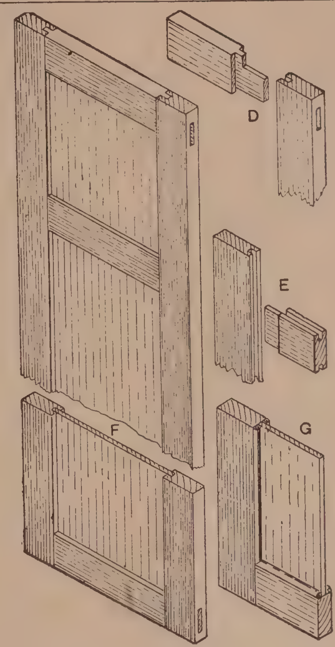


Fig. 30.—Framed Door with Details of Joints

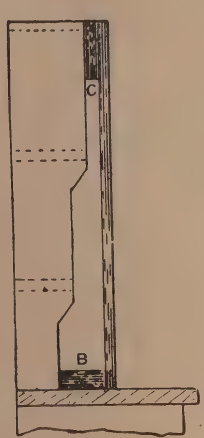


Fig. 26.—End of Dresser showing Position of Frame

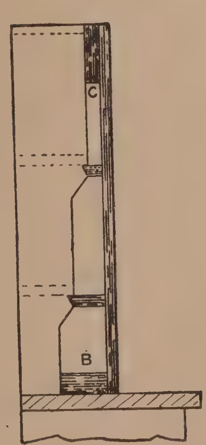


Fig. 27.—Frame Fitted to Dresser

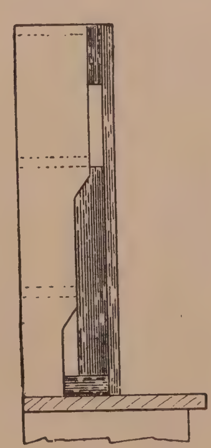


Fig. 28.—Alternative Method of Fitting Shelf Supports

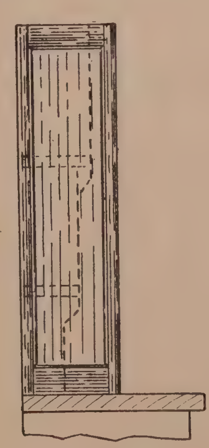


Fig. 29.—End of Dresser Fitted with Thin Board

would be easier to leave this until the doors are made and hinged, so that the hinge slots may be cut in the front frame.

The best form of door, and the one which will well repay for labour in appearance and wear, is the framed and panelled door, as shown in detail by Fig. 30. The joint for the corners is shown at D. It is

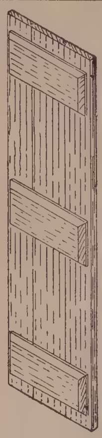


Fig. 31.—Matchboarded Door

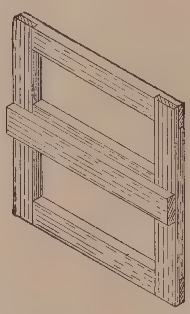


Fig. 32.—Framework for Trays in Lower Cupboards

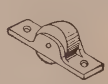


Fig. 34.—Metal Roller for Trays

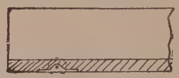


Fig. 35.—Section of Tray with Roller in Position

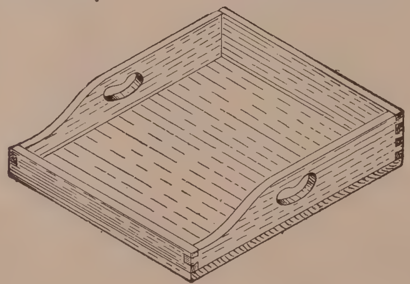


Fig. 33.—Sliding Shelf for Cupboard

called a haunched mortise-and-tenon joint, and is no more difficult to make than the ordinary form; it only requires a little more care in setting out. The joint at E is an ordinary mortise-and-tenon.

There are two methods of fitting the panel, the best being shown in section at F, where the panel of $\frac{1}{4}$-in. wood fits in a groove cut inside the framing. The alternative method, which is much simpler, is shown in section at G, the panel in this case being made to fit the inside of the frame and kept in position by beading. There are four doors to make, the centre opening being fitted with a double door, as shown in Fig. 22. Ordinary butt hinges and any kind of suitable fastening should be used. As an alternative to the framed door, the matchboarding door made as shown by Fig. 31 may be used. This is not so strong and does not look so workmanlike, but it will answer the purpose.

The shelves should now be made up to the full width of the space, and should rest on the lengths at each end already fixed in position, and on fillets of $\frac{7}{8}$-in. wood nailed on to the division boards. These shelves will be of varying widths, and probably of $\frac{7}{8}$-in. thick board to match the thickness of the original shelves. This will now complete the upper structure, and the lower portion may be tackled.

It is suggested that the drawers should be fitted with sliding compartments. The internal fittings should be arranged to fit in with the particular requirements of the house. The cupboards of these dressers are not usually convenient; they go back a fair depth, and it is not easy to get at the contents; therefore, the shelves are dispensed with and sliding shelves substituted. A framework flush with the door frames must be made and provided with runners, as shown in Fig. 32. The sliding shelves are made as in Fig. 33. These will run much more easily if fitted with rollers (Fig. 34), a section of the fitting in position being given by Fig. 35. No difficulty should be experienced here, as the work of making the trays will be quite easy. The advantage of these trays will be found when they are stocked with articles, such as tea-things, etc., for they may be washed up, placed on the tray, and put in the cupboard ready for use again. The lower portion of the cupboard doors may, if desired, be filled with a frame to hold various articles as suggested for the kitchen table; but, of course, the use to

which the movable shelves will be put must be considered first to see if there will be room.

Figs. 36 to 41. The dresser should be made chiefly of good northern pine, the top of the lower portion being of birch.

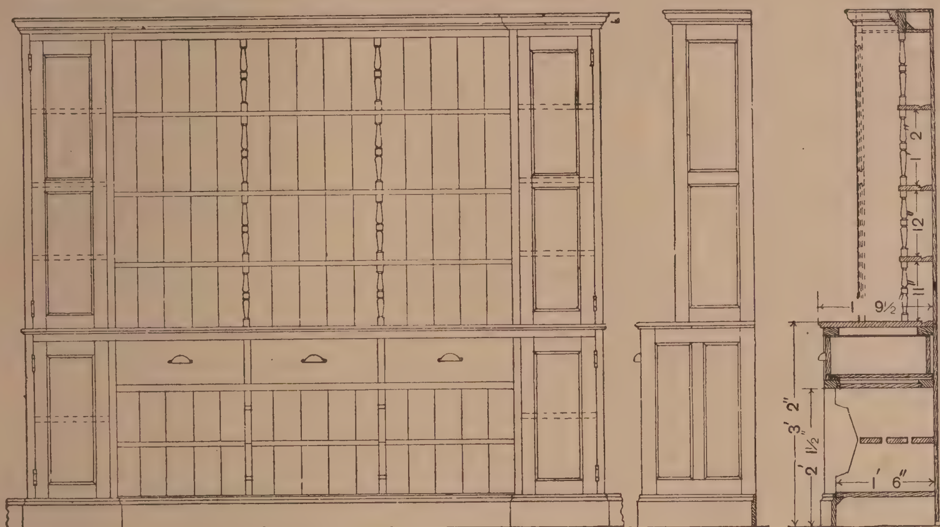


Fig. 36. Fig. 37. Fig. 38.

Figs. 36, 37 and 38.—Front and End Elevations and Vertical Section of Large Kitchen Dresser

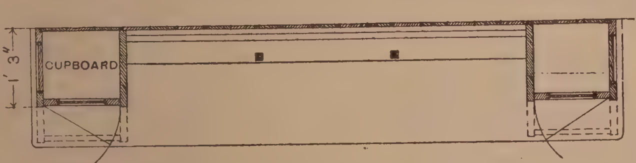


Fig. 39.—Plan of Upper Part of Dresser

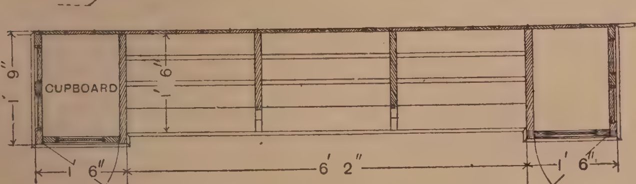


Fig. 40.—Plan of Lower Part of Dresser

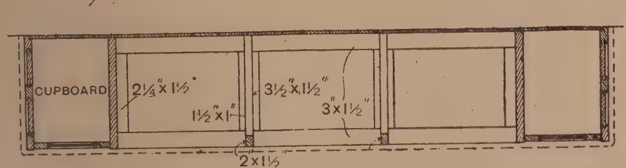


Fig. 41.—Plan of Framing under Dresser

LARGE KITCHEN DRESSER

A kitchen dresser suitable for a town house or a country mansion is shown by

The material required for the following members is $1\frac{3}{8}$ in. thick, finished: The two plain ends to the top of the cupboard, shown in Fig. 30. and the ends of the

lower part shown in Fig. 40, two standards, with shaped front, shown on section (*see* Fig. 38), and in the enlarged section (Fig. 42). The material required for pot-boards is as follows: One piece 6 ft. 4 in. by 18 in. by $\frac{7}{8}$ in. thick; and two pieces

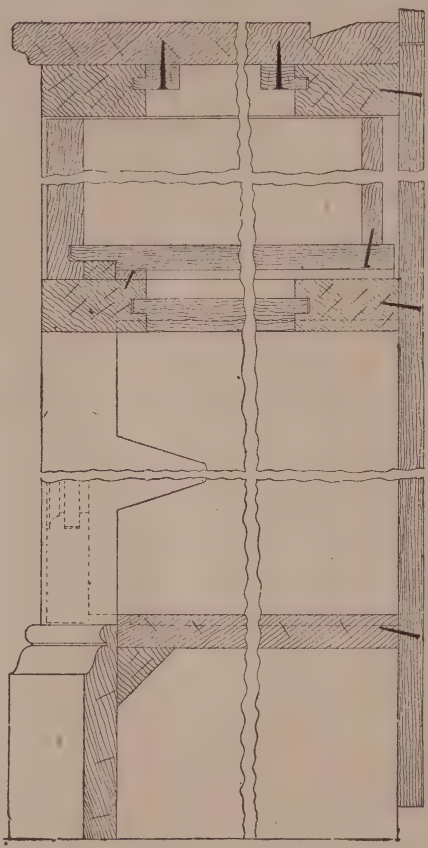


Fig. 42.—Enlarged Vertical Section through Lower Part of Dresser

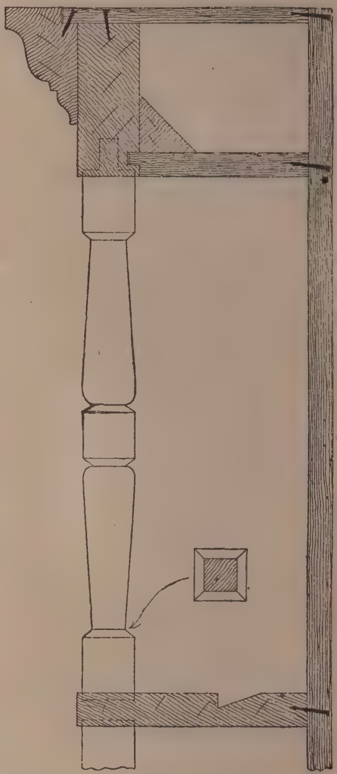


Fig. 44.—Enlarged Vertical Section showing Cornice, Baluster and Shelf

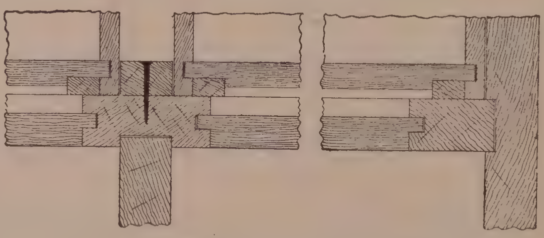


Fig. 43.—Enlarged Section of Drawers and Framing

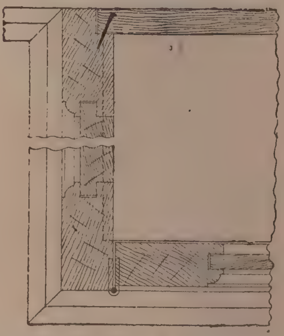


Fig. 45.—Enlarged Horizontal Section through Ends of Cupboards

1 ft. 5 in. by 20 in. by $\frac{7}{8}$ in. thick. The two shelves of the lower cupboard are each 1 ft. 5 in. by 20 in. by $\frac{7}{8}$ in.; the six shelves for the top cupboard each 1 ft. 5 in. by 13 in. by $\frac{7}{8}$ in. The three panels in the framing, forming dust-proof divisions between the drawers and the lower cupboard, as shown on section (Fig. 38), and on the plan of the framing (Fig. 41) and enlarged section (Fig. 43), are each 1 ft. 11 in. by 16 in. by $\frac{7}{8}$ in. thick, finished; three drawer bottoms, each 2 ft. 1 in. by 20 in. by $\frac{1}{2}$ in. thick, finished (*see* the enlarged vertical section illustrated by Fig. 42). The birch top should be cut off 2 in. longer than the required length, which is 9 ft. 4 in. by 22 in. by $1\frac{1}{8}$ in., finished thickness, as shown in Fig. 42. The whole is grooved for cross-tongueing, the groove in the birch top to be stopped 3 in. from each end. The eight balusters are turned, as shown in Fig. 44. The panels in the framing at the ends are flush on the inside, as shown in Fig. 45.

The trellis pieces at the open portion of the lower part of the dresser are cut in lengths fitting between the standards and ends of the cupboards, and are housed in $\frac{1}{2}$ in. at each end, as shown by Fig. 38. The bottom rails of the lower portion of the dresser are dovetailed at the ends. Fig. 46 shows the construction of the front and back rails of the dresser under the birch top, as well as the construction of the two inner ends of the cupboard. The top rail at front and back is dovetailed to the two outside ends. The lower rail at front and back under the drawers is tenoned and mortised; the shoulder inside the rail being housed in the end to the same depth as the rail forming the runner. The two muntins between the three drawers are tenoned, mortised, and housed, as before described. The shaped standards are housed in the pot-board (stop-housing) at the front, as shown by dotted lines in Fig. 42. The pot-board of the two end cupboards is tongued as shown in Fig. 47. The shelves in the cupboards are housed in the ends as shown by dotted lines in Fig. 45.

The rail forming the runner for the drawers is grooved on the underside to

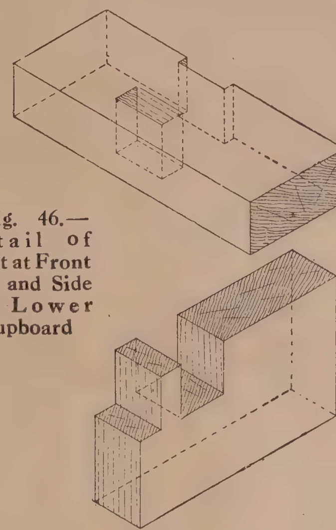


Fig. 46.—Detail of Joint at Front Rail and Side of Lower Cupboard

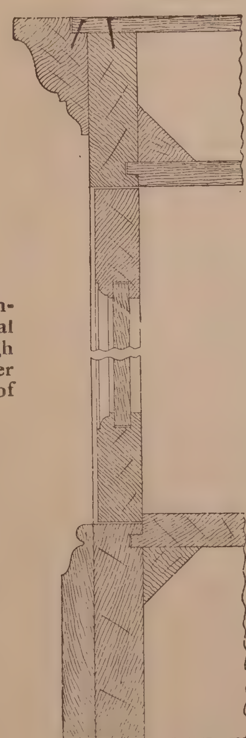


Fig. 47.—Enlarged Vertical Section through Top of Upper and Bottom of Lower Cupboards

receive the top end of the standard as shown in Figs. 42 and 43. The top rails under the cornice are dovetailed. The three shelves at the top portion of the dresser are sunk, as shown in Fig. 44. The three shelves are housed $\frac{1}{2}$ in. deep into the ends of the cupboards, the housing being cut to fit the sinking in the shelf. The two top balusters are tenoned into the top rail, and are housed in as shown in Fig. 44. The four ends of the lower cupboard run down to the floor, and three bearers, each 5 in. by $1\frac{1}{2}$ in., are fixed under the pot-board, and glue-blocked as shown in the various sections. The four ends of the top cupboard are housed $\frac{1}{2}$ in. into the top of the lower portion of the dresser, and stopped. The sinking for plates at the top (Fig. 42) is stopped between the two ends of the cupboard. The birch top is buttoned down, as shown in Fig. 42. The doors are hung with two 3-in. steel-butts, each door being fitted with a small mortise lock and drop handle, while each drawer is fitted with an ordinary grip handle or with turned wood-knobs. Stop-drawers at the front are shown in Fig. 42.

The front and ends of the dresser should be painted in three oils of an approved tint, or grained; the whole being twice varnished.

KITCHEN DRESSER WITH ENCLOSED CUPBOARDS

A kitchen dresser of a similar type to the one last described but of more simple construction is shown in front elevation by Fig. 48.

Figs. 49 and 50 show two vertical sections, and plans of the upper and lower parts are given by Figs. 51 and 52. This dresser could be adapted for a position against a blank wall or could be placed in a recess. Selected red deal or pitchpine would be suitable woods.

The lower portion consists of cupboards and drawers. The doors of the cupboards should be 1 in. thick framed up with panels moulded on the face, as shown in Fig. 53. The drawers should be fitted with 1 in. fronts, and the top above the drawers (*see* Fig. 54) should be 1 in. thick with plain moulding on the edges secured to the framing below. The upper portion of shelving should preferably be made separate from the lower portion, as the dresser will then be more portable than if constructed in one piece. The sides of the shelving should be 1 in. thick, shaped as shown, and fitted with two tiers of shelving supported with turned balusters $\frac{3}{4}$ in. square. The top cornice (Fig. 55) should be cut out of $1\frac{1}{2}$-in. stuff, blocked at intervals for strengthening purposes. Below this are fixed cut and shaped heads $\frac{1}{2}$ in. thick housed into brackets and side cheeks. The back is covered with $\frac{1}{2}$-in. V-jointed boarding in narrow widths. The lower cupboards should be fitted with brass latches and the drawers with plain drop handles; brass hooks for cups and jugs should be fixed on the edges of the shelving. The dresser, when finished, should be either painted to match the existing woodwork or stained and twice varnished.

SMALL SIDEBOARD

A pleasing design for a single sideboard is shown by the half-tone reproduction (Fig. 56). Figs. 57, 58 and 59 show front elevation, vertical section and plan respectively. Of the four uprights the two at the back can be quite plain and finished about 2 in. by $1\frac{1}{2}$ in. The front uprights are 2 in. square (finished), and have chamfers, as at A in Fig. 60, stopped 12 in. above the floor B (Fig. 57) and running into the small turned finials at the tops. One of the latter is shown to a large scale in Figs. 61 and 62, the octagonal section formed by the chamfers being finished with a slight hollow, as at C in both figures. Above this the uprights are round-turned to the design given. At a height of 7 in. above the floor the front legs are sunk $\frac{1}{16}$ in. all round, and thence tapered downwards to $1\frac{1}{4}$ in. square. Three $\frac{7}{8}$-in. or $\frac{3}{4}$-in. shelves will be required, and they should be moulded, as in Fig. 63, on three sides. Along the front and ends they are supported by means of $\frac{7}{8}$-in. by 2-in. rails, as at D in Figs. 58 and 63. These rails are tenoned into the uprights, the front two

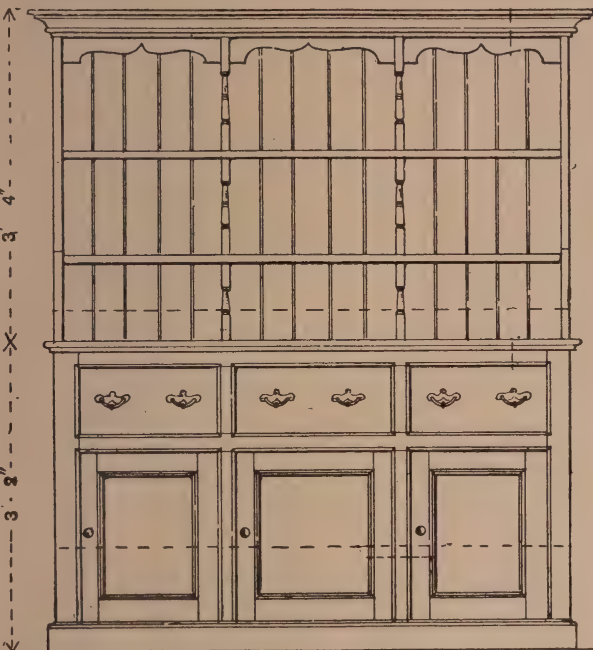


Fig. 48.—Front Elevation of Dresser with Enclosed Cupboards

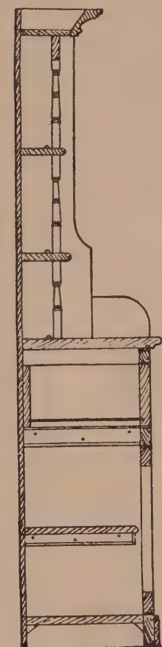


Fig. 49.

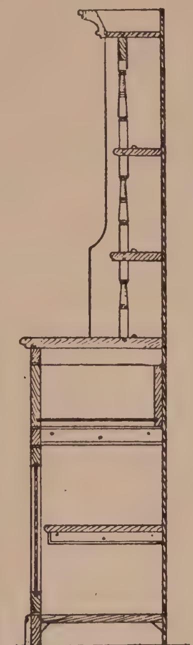


Fig. 50.

Figs. 49 and 50.—Two Vertical Sections showing Alternative Methods of Finish to Ends

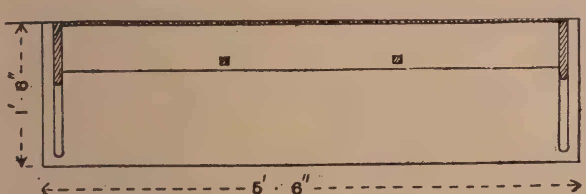


Fig. 51.—Plan of Upper Part of Dresser

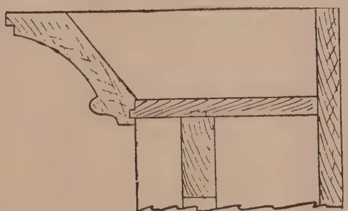


Fig. 55.—Section through Cornice

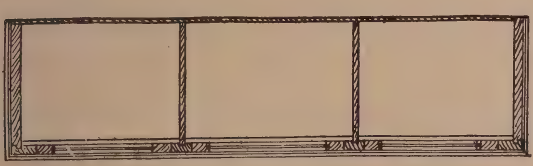


Fig. 52.—Plan of Lower Part of Dresser

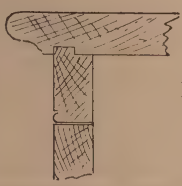


Fig. 54.—Section of Top above Drawers

Fig. 53.—Section through Stiles of Doors

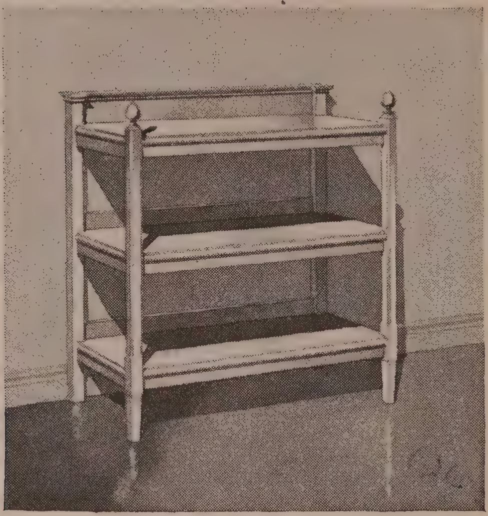


Fig. 56.—Small Sideboard

close intervals from behind, their ends being first halved or notched into the back uprights as in Fig. 59, and the whole finished flush at the back. The top shelf is treated in exactly the same manner, except that its rail F (Fig. 58) is 5 in. deep, and is finished with a small capping mould either rebated or planted in position and continued over the back uprights by means of flat, solid caps $3\frac{1}{2}$ in. by 3 in., moulded and mitred as required, and sunk underneath to fit $\frac{1}{4}$ in. over the posts.

SIDEBOARD DRESSER

A sideboard dresser which harmonises admirably with old-world interiors is shown by Fig. 64. From the point of view of utility it must be confessed that a sideboard dresser of this type is not so

of which take two rails at each level, the tenons being arranged as in Fig. 60, in order that the longest rails may be jointed the farthest into the uprights. When the rails and uprights have been framed up, the shelves can be cut away at the corners as necessary, carefully fitted into position, and screwed from the underside obliquely through the rails.

A skirting being desirable along the back edge of each shelf, this is made to take the place of the rail which would otherwise be necessary below the shelf to ensure the required amount of rigidity. For the two lower shelves this skirting takes the form of pieces $\frac{7}{8}$ in. by 3 in., having their lower edges flush with the undersides of the shelves E (Fig. 58), to which latter the rails are screwed at

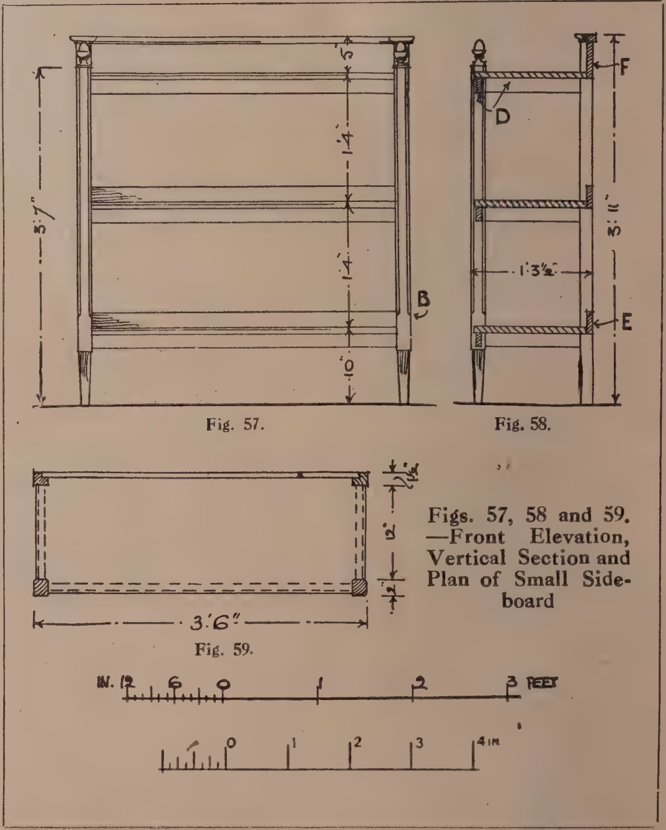


Fig. 57. Fig. 58. Fig. 59.

Figs. 57, 58 and 59.—Front Elevation, Vertical Section and Plan of Small Sideboard

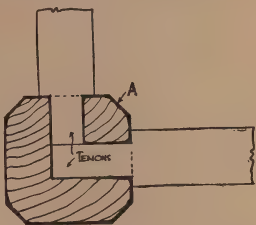


Fig. 60.—Joint between Rails and Front Uprights

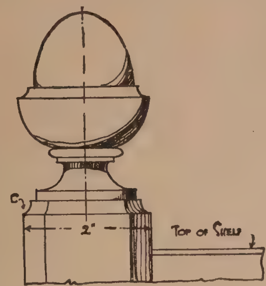


Fig. 61.

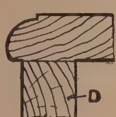


Fig. 63.—Moulded Edge to Shelves

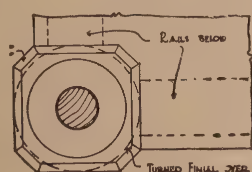


Fig. 62.

Figs. 61 and 62.—Elevation and Plan of Finials

satisfactory as one designed along Sheraton or Chippendale lines; but it should be pointed out that many people prefer a good display of china to provision of cellaret drawers and other fittings. A sideboard dresser of this type provides a fair amount of drawer accommodation for linen and cutlery, and the cupboards in the top part serve admirably as receptacles of small articles of plate, cruets, etc.

The constructive features of the sideboard dresser shown in front elevation by Fig. 65 do not present any special difficulties. A half-sectional plan through the drawers is shown in Fig. 66, illustrating the construction of the divisions. It will be noticed that a clamp is fixed to the front of the division at each end of this and the corresponding one; on the other half, tenons are cut which fit into the top rails and bottom of the dresser. The divisions should be grooved into the back and finally secured by screwing through. Fig. 67 shows the connection of the shelf to the legs. Both ends of the bottom part should be tenoned into the legs, and the span rail of the front should be tenoned to the bottom previous to tenoning this part into both the front and back legs. The insides of the carcase ends should be grooved to receive the ends of the bottom. An enlarged detail of one corner of the drawer part, with broken corner mouldings fixed, is shown in Fig. 68. This detail also serves for the cupboard doors in the upper part.

To construct the top part, the best plan is to carry each end right through from top to bottom; all shelves are then slip-dovetailed between the ends (*see* Fig. 69), and the cupboard bottoms dovetailed up. To bind the top part together the span rails are also slip-dovetailed between the carcase ends and made flush at the front. An enlarged detail is shown by Fig. 70 illustrating the method of fixing the cornice moulding round. The latter is allowed to project above the ends in order to receive the dust-board, which is screwed down and levelled off. The matched back with V-joints is quite suitable for a sideboard of this type, and an enlarged detail of the matching is shown by Fig. 71. Fig. 72 shows the construction of the cupboard doors, made in one piece with

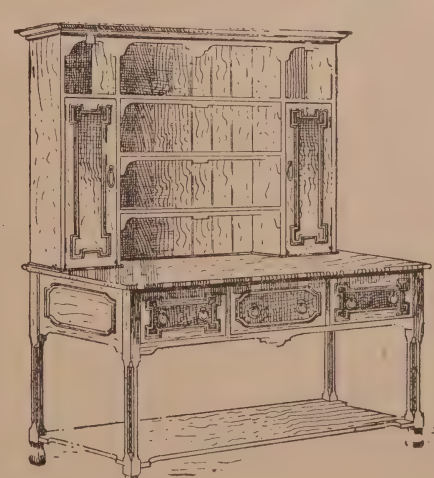


Fig. 64.—Sideboard Dresser

clamps at each end. Round the bottom of the top part a small half-round moulding should be rebated and mitred, which forms a neat finish between the upper and lower part.

The metal-work suggested for the sideboard is armour-bright iron. The handles could be of a ring shape as shown, or handles with pear-shape drops could be introduced with advantage.

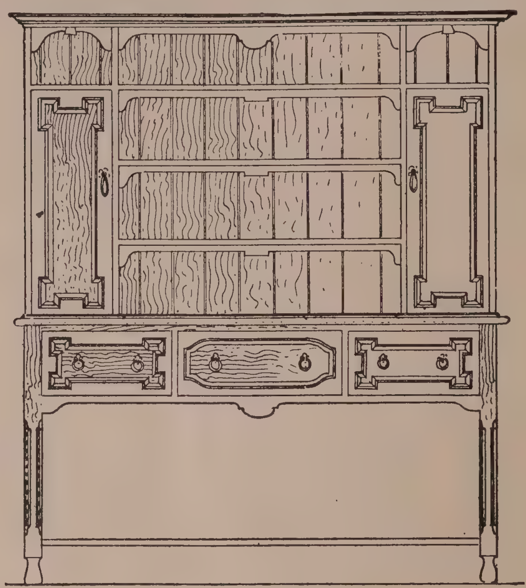


Fig. 65.

Fig. 66.

Figs. 65 and 66.—Front Elevation and Two Half Plans of Sideboard Dresser

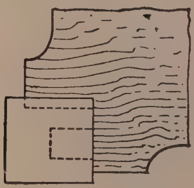


Fig. 67.—Detail of Shelf

Fig. 72.—Construction of Cupboard Doors

Fig. 69.—Method of Fixing Shelves

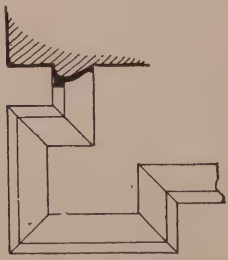


Fig. 68.—Detail of Corner

Fig. 71.—Enlarged Detail of Matchboarded Back

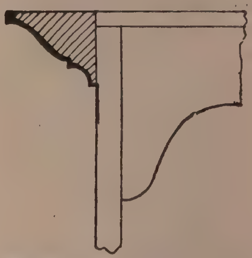


Fig. 70.—Enlarged Detail of Cornice

ANOTHER SIDEBOARD DRESSER

The constructional work of the further example of sideboard dresser shown by Fig. 73 is on identically the same lines as the preceding one, and therefore no useful purpose would be served by giving details. This sideboard is simply included here as presenting an alternative design, and the craftsman who desires to make it should study the construction in conjunction with that just described.

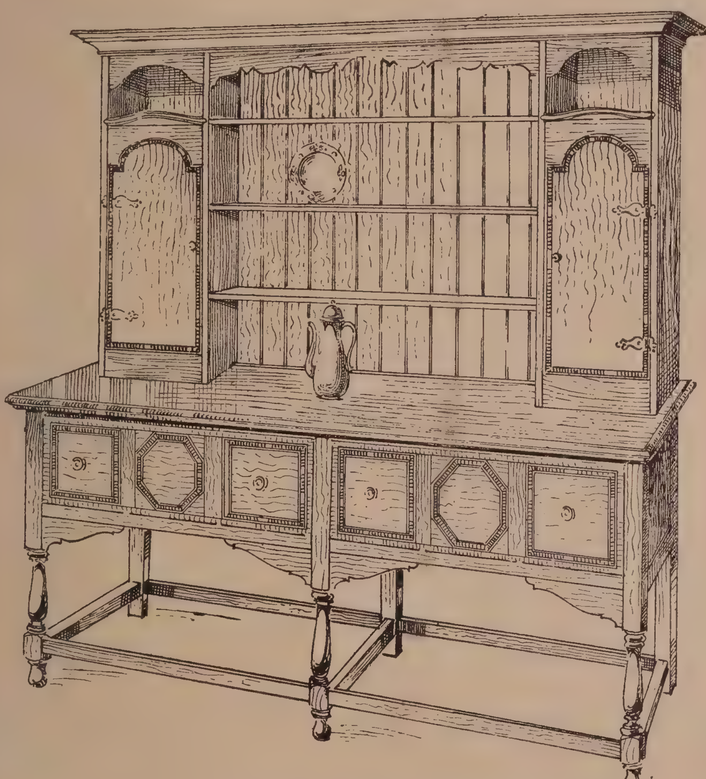


Fig. 73.—Alternative Design of Sideboard Dresser

DRESSER SIDEBOARD WITH SLIDING DOORS

An oak dresser, fitted at the top with sliding glazed doors, is shown in the half-tone reproduction (Fig. 74). Two elevations and an enlarged vertical section are shown by Figs. 75, 76 and 77.

The dresser is made in two distinct portions, the lower one having four front legs 2 in. or $2\frac{1}{4}$ in. square, but circular-turned at a point just above the floor, as in Fig. 78. There are also four 2-in. or $2\frac{1}{4}$-in. by $1\frac{1}{2}$-in. back legs, not turned at all. These eight legs are connected up by means of top and drawer rails at the front, back and ends, as at A and B in Fig. 78, and as shown in section by Fig. 77. The drawer spaces should be fitted with the necessary guides, runners, and drawers, the fronts of the latter being recessed when shut, and having a small moulding mitred round them. Panels should be

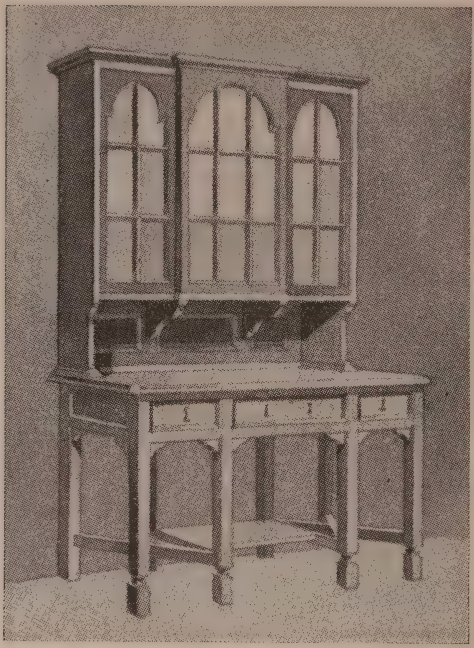
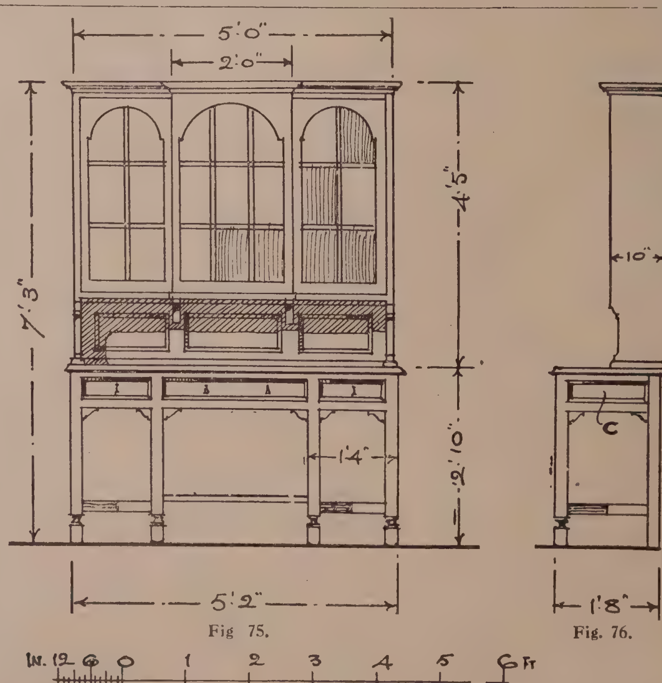


Fig. 74.—Dresser Sideboard with Sliding Doors

formed at the ends, as at C in Figs. 76 and 79, and mouldings applied to match the drawers, and ultimately ten small cut brackets should be fitted where shown. Near the floor the legs should be connected by means of $1\frac{1}{2}$-in. by 2-in. diagonal braces, as in Fig. 80, halved in the middle where they cross. Similar rails should be framed in as at D in the same figure, to take a central shelf about 1 ft. 3 in. wide. A $\frac{3}{4}$-in. moulded top will complete the lower half of the dresser.

The upper portion should be built up of sides, top and lowest shelf, finished about $\frac{3}{4}$ in. thick, the top moulded and made into a cornice by means of a small hollowed fillet, as at E in Fig. 77, which also shows at F the shaped outline for the sides. The latter should be housed $\frac{3}{8}$ in. deep into 2-in. by 1-in. moulded feet G (Figs. 77 and 78), the line of which is continued against the back by means of a moulded fillet as at H. If possible, the whole back should be panelled; but in any case the lower open portion should



Figs. 75 and 76.—Front and End Elevations of Dresser Sideboard with Sliding Doors

be in three moulded panels, set out to correspond with the glazed divisions above. Two cut brackets and a small top moulding J (Figs. 77 and 78) will complete this portion.

Dealing next with the glazed front, metal tracks will be best for these, although they can be grooved top and bottom to run on rounded oak tongues, as at K in Fig. 77, if desired. Fig. 81 is a detail part plan of this. The small top-rail at L (Fig. 77) as shown should run

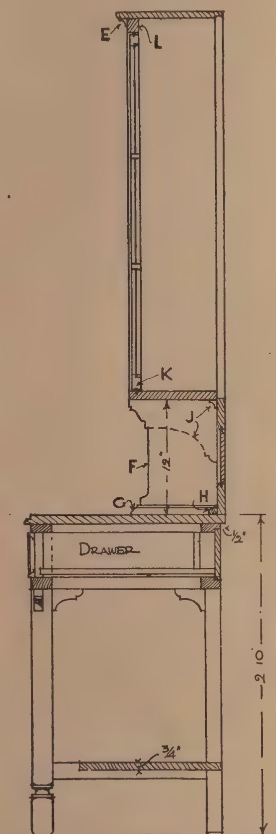


Fig. 77.—Enlarged Vertical Section of Dresser Sideboard with Sliding Doors

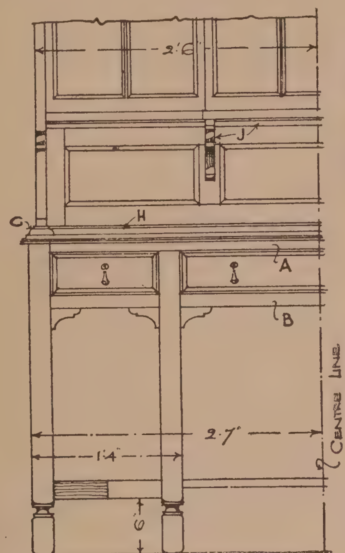


Fig. 78.—Enlarged Part Front Elevation

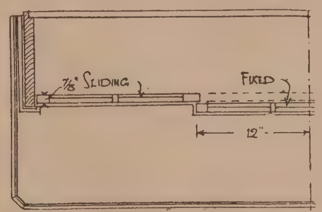


Fig. 81.—Detail Part Plan of Sliding Doors

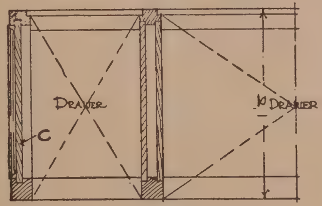


Fig. 79.—Enlarged Part Horizontal Section above Drawers

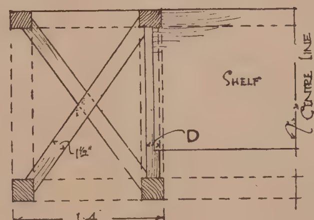


Fig. 80.—Enlarged Part Plan above Shelf

this should be about ⅞ in. thick, and all well framed in the ordinary manner. The side lights slide towards the centre behind the middle one, which is fixed and projects as shown, the top and bottom shelves being broken out to suit it. It should overlap the side lights ½ in., and right across behind the middle light, and it will be essential to make it exactly parallel to the lower shelf, in order to let the lights slide properly. By opening the side lights it will be quite simple to reach the spaces behind the fixed central portion. If possible, the shelves should

coincide with the horizontal glazing-bars in level.

MAHOGANY SIDEBOARD

The eminently useful example of dining-room furniture illustrated in Fig. 82 (finished perspective view) has been designed to show the possibilities of a sideboard which does not involve very difficult practice or expensive detail, and readers will no doubt admit that the simple lines of the example introduced are much to be preferred to the "many-mirrored" type of sideboard. Front and end elevations are shown by Figs. 83 and 84 on the opposite page.

The decoration of this sideboard is chiefly obtained by the judicious arrangement of well-figured veneers, and an additional decorative feature consists of shaped edges to the doors and frames. As will be seen from the various views, the shaping is based upon a "repeating" unit, and this detail, as well as the remainder of the design, shows much better in the actual material than in plain black-and-white.

The elevations of the sideboard show the projection of the top part of the back. This is necessary in order to allow for the thickness of the skirting which would otherwise prevent the top part fitting close against the wall. In some instances similar considerations necessitate making the whole of the bottom part flush at the back, in which case the curve shown on the leg would be omitted. This would not seriously affect the appearance of the sideboard, and has the effect of reducing the overhang or back projection of the top part. Two sectional views of the

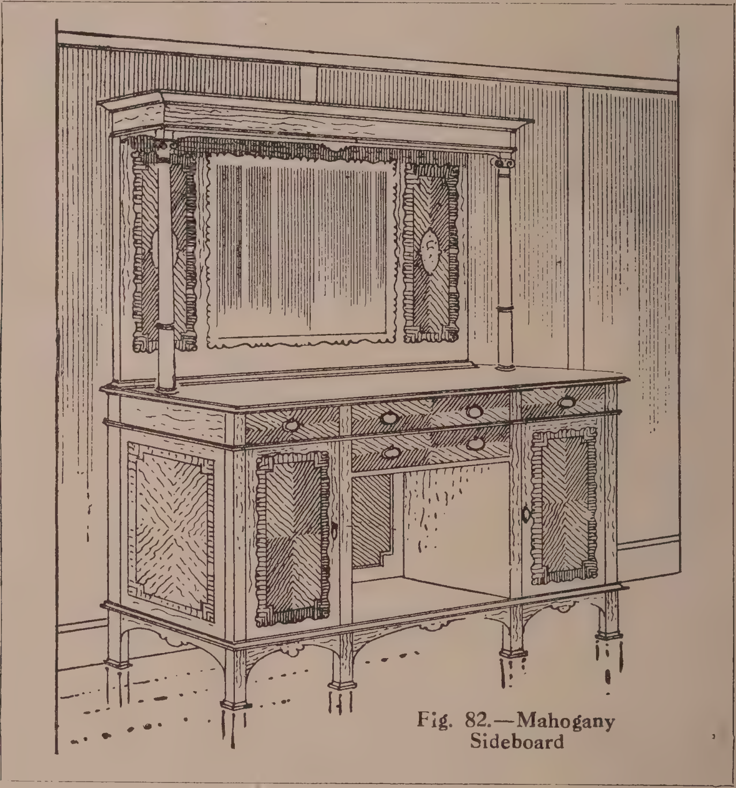


Fig. 82.—Mahogany Sideboard

sideboard are shown by Figs. 86 and 87, which illustrate the construction.

A detail of the decorative shaping used on the doors and frames is also shown in Fig. 86, and this would be executed by simply fret-sawing to the shape shown and finishing with fine files and glass-paper. The shaped part is, of course, only about 1 in. thick, and represents the projecting parts of the framing forming the rebate.

The first step in making the sideboard would be to prepare the four carcase ends, and to dowel the two outside ones into the legs. Before they are glued together, the insides of the ends should be trenched to receive the drawer runners, as shown in the first sectional view. The inside ends are then dowelled only into the front legs, as they are secured at the back to the main panelled back, there being only six legs. Both sides of the

Fig. 83. Fig. 84.

Figs. 83 and 84.—Front and End Elevations of Mahogany Sideboard

Fig. 85.—Detail of Decorative Treatment of Doors, etc.

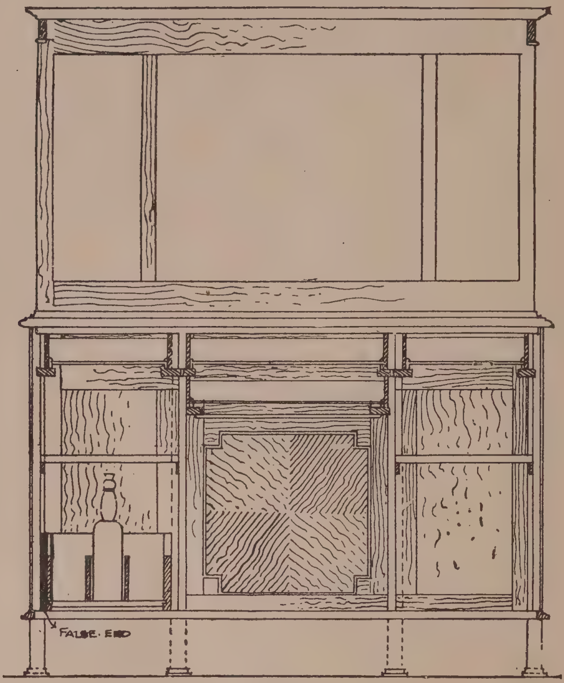


Fig. 86.

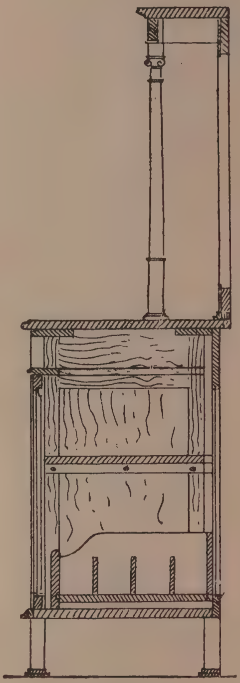


Fig. 87.

Figs. 86 and 87.—Part Sectional Front and End Elevations of Mahogany Sideboard

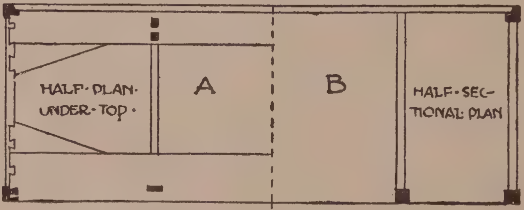


Fig. 88.—Two Half Plans

Fig. 90.—Section of Top Mould

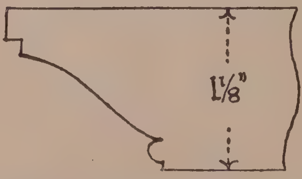


Fig. 89.—Section of Mould on Top Part

Fig. 92. — Section of Mould at B (Fig. 94)

Fig. 91. — Section of Mould at C (Fig. 94)

Fig. 93.—Section of Mould at A (Fig. 94)

inside ends must be trenched to receive drawer runners, and the short drawer rails may then be tenoned in between the glued-up ends. The method of attaching the top rail is indicated at A in Fig. 88, from which it will be seen that the ends are pinned through the rails and the latter are dovetailed down into the carcase ends and legs. Triangular brackets are attached to the rails, these serving for additional strength and economise the material. Reference to Fig. 87 shows the bottom running right through underneath the carcase ends. The legs should, of course, be housed to receive it, and the inside legs may be screwed to the carcase bottom underneath the moulding, the latter being fixed after the carcase has been glued together. At the bottom of the left-hand cupboard a cellaret drawer should be introduced; this necessitates the use of a false end (*see* Fig. 87). The sectional view (Fig. 86) shows the shaped ends for this part, and also the divisions which need not be made the same width of the ends. A necessary feature of a cellaret drawer is the lead lining which is usually soldered in after the woodwork has been completed. The shelf above the cellaret provides for cruets and small articles of plate, and the right-hand cupboard proves useful for reserve bottles, knife-cases and like articles indispensable to a well-equipped dining-room.

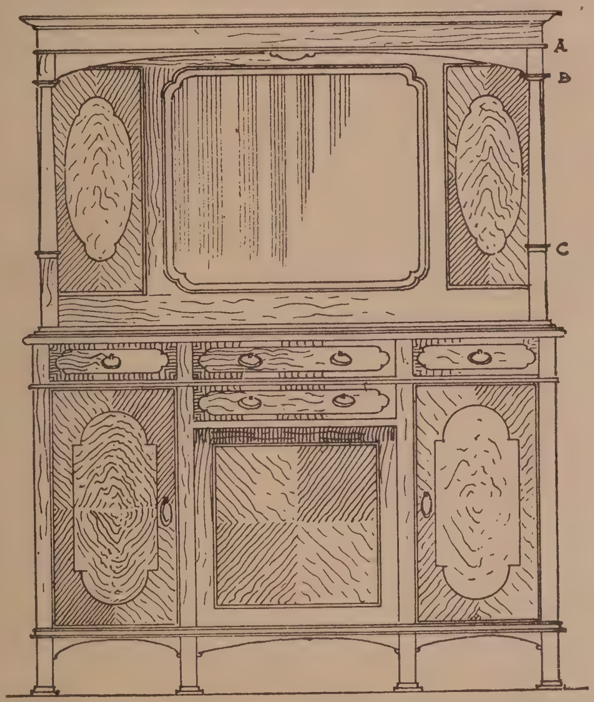


Fig. 94.—Front Elevation of Mahogany Sideboard showing Alternative Decorative Treatment

The drawers are made in the usual way and veneered with quartered patterns. An added decorative touch is imparted to this part of the work by adding cocked beads which project beyond the face of the work. With cocked beads the face of the drawer front should be in exactly

the same plane as the front legs, and the bead then breaks the joints between them, and also protects the edges of the veneer which would otherwise chip away through coming in contact with the drawer rails. The curved span rails at the bottoms should preferably be made in three pieces, and each one mitred up in order to obviate the short grain which would inevitably break away if the rails were cut from the solid. At the bottoms of the legs small moulded blocks are either screwed or dowelled on to act as feet.

The sectional view (Fig. 87) shows the groundwork of the back frame. This should be made of Honduras mahogany with square edges, and then the front part is faced up with Cuba mahogany. The cornice is made with three rails secret-mitred at the corners with frieze mouldings underneath. A moulded top is prepared to fit right over the frame, and this is secured by pocket-screwing through the insides of the cornice rails. The base moulding is worked in one piece moulded on three sides, and is screwed up to the back frame. To fix effectively the columns, the squares should run to the underside of the moulded top, and to effect this it is necessary to cut this away for the cornice which leaves a projecting horn which may be screwed to the rails. In cases where the top part must be made as a separate feature, a good plan is to mortise and tenon three base mouldings, which act as a sufficient tie or brace for the top part. The shaped rails underneath the frieze moulding are simply fitted in between and then glued up to the moulding.

The centre elliptical shapes in the panels are intended to be executed in curl veneer (described in a later section), and may be cut to the desired shape by placing the two pieces in between two pieces of quarter stuff with pins to secure the whole. The shape may then be fret-sawn and finished with fine files previous to separating them. The quartering should not present any special difficulties, and in this particular instance it would probably economise time to cut in the elliptical centre parts after the quartered veneers had been glued down. The back of the bottom part has necessarily to be made in one piece; this is indicated in the sectional view, from which it will be seen that the top rail has to be made wider in the centre part in order to make the proper margin. The square or broken corners can be added to the rails for purposes of economy. A panelled back of this kind is very strong, and when rebated into the legs, as shown at A in Fig. 88, and screwed to these and the carcase ends great rigidity is obtained.

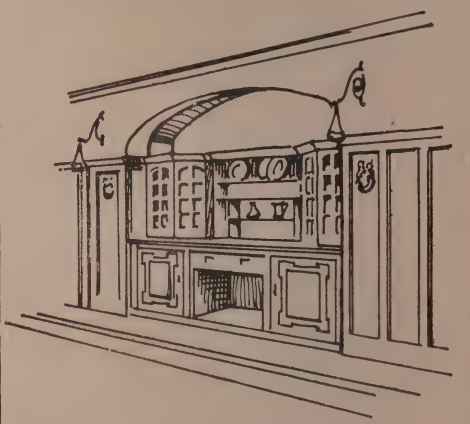


Fig. 95.—Sideboard Fitting for Recess

Details of the moulds are shown by Figs. 89 to 93.

An alternative decorative treatment is indicated in the second elevation shown in Fig. 94. The constructional features are almost identical to those in the first elevation. The veneered designs are different, and flush veneered-doors are substituted for the framed ones. These flush doors are made with clamps mortised and tenoned on, with cocked beads fixed as with the drawers after the veneering has been completed.

SIDEBOARD FITTING FOR A RECESS

Well-planned houses are now frequently arranged with a recess in the dining- or

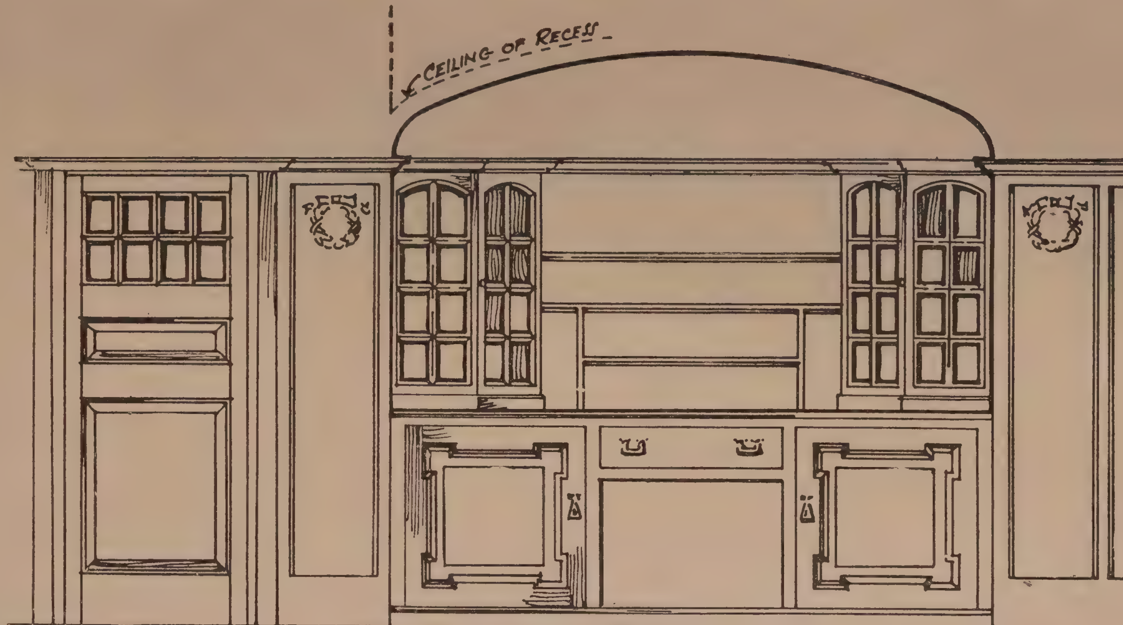


Fig. 96.

Fig. 97.

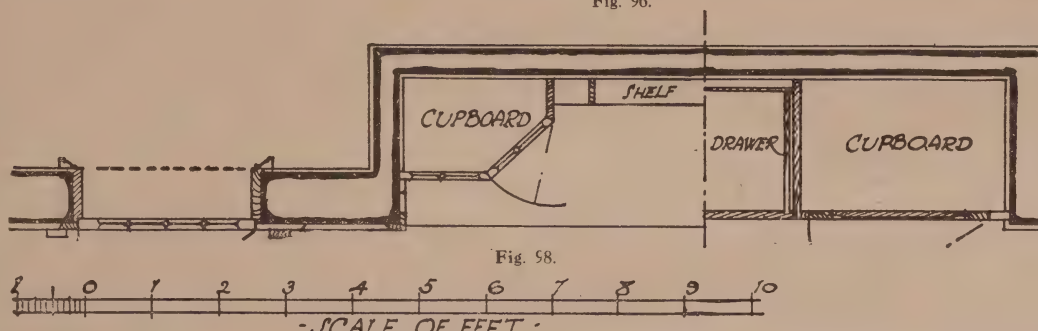


Fig. 98.

Figs. 96, 97 and 98.—Front Elevation, Vertical Section and Plan of Sideboard Fitting for Recess

living-room, intended to accommodate a sideboard or similar piece of furniture, and this constitutes not only an economy in space, leaving the whole room free from obstruction, but can be made a picturesque feature of the apartment, second only to the fireplace in importance.

An unpretentious scheme for decorating a room, with special reference to such a recess, having a sideboard fixed permanently in position, is shown in perspective and front elevation by Figs. 95 and 96. A section and plan are shown by Figs. 97 and 98. The walls are covered to a height of 7 ft. with light framing, having canvas of some suitable colour stretched behind it to form panels of this material, some of which are ornamented with a stencilled wreath or festoon as indicated. This framing should be screwed from the front with brass cups and screws to wood plugs or grounds, in order to allow of removal for the purpose of renewing the canvas. At the 7-ft. level a moulded capping is continued round, and the frieze above is plastered in the ordinary way, or rendered and floated only, as is sometimes preferred, to obtain a more interesting texture. The door and linings suggested to be used are shown on the left-hand side of the drawing.

The recess measures 9 ft. across, and is 2 ft. 3 in. deep; it has a table-top 3 ft. 3 in. above the floor, fitted underneath with a central drawer for tablecloths, and a cupboard on either hand. The doors to each of the latter have raised panels, and the frames are cut to suit the mitres shown for the panel mouldings. A reference to the plan (Fig. 98) will explain the arrangement of the upper part above the table-top, which comprises two angle cupboards with glazed fronts and doors in small panes with wood bars, and shelving fitted in the middle between the cupboards. The moulded capping runs round the top as a finish, and above it is an elliptical or segmental arch, probably only in lath and plaster, to which the small ceiling behind is shown running parallel. The wall behind the cupboards and shelves would be plastered, and the glazing to the door of the room and cupboards might have a few bull's-eyes introduced at random if a quaint effect is desired.

Any description of finish can be employed for the joinery, although it is usual in a room of this description to keep the tones dark or subdued, in order to set off the glass, silver, and linen of the table to the best advantage. A small sketch given by Fig. 95 on page 814 gives some idea of the general appearance when the design is carried out.

Coal-boxes

OAK COAL-BOXES

Wooden coal-boxes as articles of furniture are a considerable improvement on the metal types. From a decorative point of view, of course, a good brass or copper scuttle is excellent, but so many are made simply of sheet-iron " brassed " over, and they soon look dingy because of the colour wearing off. Wooden coal-boxes can be designed and made to match the other furniture in the room, which is an advantage. The general shape or design is usually on the lines shown by Fig. 1, but a pleasant variation is to make a pair of folding doors instead of a flap. The example shown in front elevation and section by Figs. 1 and 2 is intended to be made in oak inlaid with ebony and rosewood, or dark brown oak and rosewood.

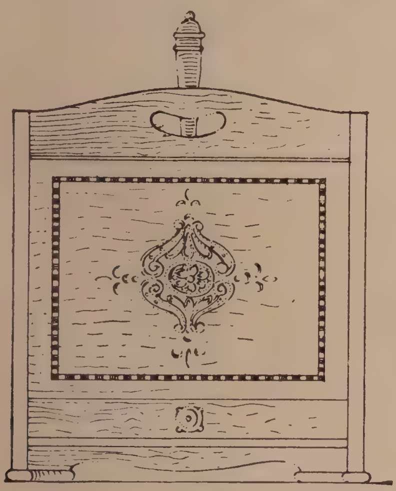


Fig. 1.

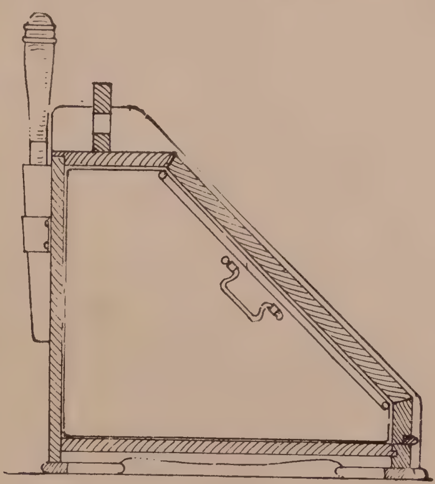


Fig. 2.

Figs. 1 and 2.—Front Elevation and Section of Oak Coal-box

To make the case part, both ends should be planed perfectly flat, and then shaped exactly to the outline shown in the sectional view. Shaping both at the

same time ensures exact similarity and much facilitates the work. Both the top and the bottom should be slip-dovetailed

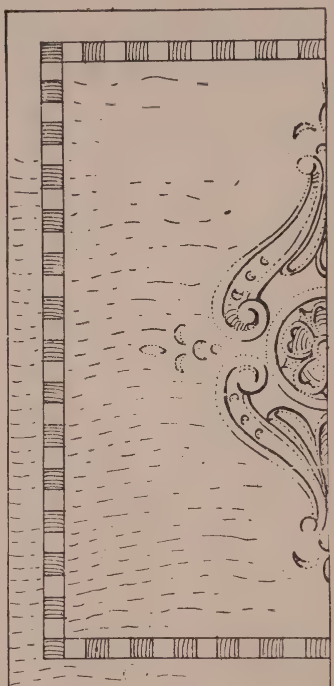


Fig. 3.—Enlarged Detail of Carved Door

in. The bottom front piece should be dowelled in between the sides, and grooved both back and front for the bottom and moulding. Both sides should be rebated on the back edges, and the back piece can then be made to fit exactly, and is then screwed in. The handle piece should be made ½ in. longer than the space between the sides, and is then stop-grooved ¼ in. deep at each side, and inserted before the case is glued up. It will be seen on referring to the sectional view that the fall or flap has the grain running from side to side, with a narrow bottom piece glued on, to which is attached the knob. An ordinary rubbed joint is quite suitable for this part if carefully made. Running the grain from side to side has an additional advantage, as the hinges can be better secured to long-grain wood instead of end-grain wood. The curves underneath the box should be cut with a bow-saw, and filed and glass-papered before the box is glued up. The feet can be made by working a length of wood to the required thickness, afterwards rounding one edge as shown. This is then cut into short lengths as desired, rounding off the ends as required. For instance, the left-hand foot shown in the front elevation (Fig. 1) may be taken as an example. A short length is cut off, and then rounded at each end and screwed up to the box. The return piece in the front is then cut, and one end rounded. The left-hand end of this piece is made dead square, and then a mitre is made, so that it can be fitted into the fixed piece by cutting another small mitre on the side, thus forming a butt-and-mitre joint.

Interlaying is dealt with in a later section, and also carving. The carved centre in this case is adapted from the simple carved designs found on old oak chests, and a study of these will afford much assistance when designing work of this type. To execute this part, half the design (Fig. 3) should be carefully drawn, and then transferred to a smooth chalked surface by means of carbon paper. The outline can then be cut with gouges, and the various reliefs and modelling proceeded with.

The hinge used for the flap is usually

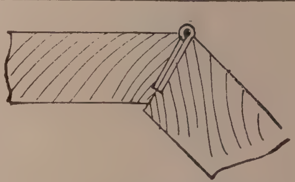


Fig. 4.—Sectional Detail of Coal-box Door Hinge

termed a piano hinge, because of its use in hinging piano falls and tops. The wings or flanges are much thinner than

those used in ordinary hinges, and they may be purchased cut to any required length. As the hinge runs right through the hinging piece on top and the top edge of the flap, the necessary sinking for each flange can be obtained by simply rebating the edges, as is indicated in the section shown (Fig. 4). To obtain the proper gauging for this part, a marking gauge should be set from the edge of the flanges when the hinge is closed to the centre of the pin or knuckle. The gauge is then employed to gauge the rebate lines.

It will be found in actual practice that an iron lining (*see* Fig. 2) is desirable. These are usually made with inside handles, which fold down close to the sides when not required for carrying the lining, and have the advantage of enabling one to carry and fill the lining without actually handling the wooden box. Though usually introduced they are not absolutely necessary.

MAHOGANY COAL-BOXES

The construction of the coal-box shown by Figs. 5 and 6, which is intended to be executed in mahogany inlaid with satin-wood, is simpler than the preceding one, the top being slip-dovetailed between the sides, and the bottom lap-dovetailed into the sides. A plinth is formed by working the moulding shown in two lengths, which are rebated in and mitred round after the case has been glued up. The ball feet indicated are then attached by screwing to the bottoms of small blocks glued in the corners. At the top, mouldings are glued round as indicated. The door is made as a frame with a veneered and inlaid panel grooved in before the frame is glued together, and is finished level with the framing at the back.

If desired a pair of folding doors could be fitted. There is not any real need of separate frames with panels with such small doors; instead, each door should be made from a piece of $\frac{3}{4}$-in. stuff stiffened at the back by means of a pair of clamps each about $1\frac{1}{2}$ in. wide by $\frac{3}{8}$ in. thick, dove-tail keyed in flat. Another method of ensuring flat surfaces is to prepare two hardwood clamps each about $1\frac{1}{4}$ in. wide by $\frac{3}{8}$ in. thick. These are rebated and glued at the ends of the doors on the back sides, and then planed off perfectly level all round. These clamps serve to keep the surfaces quite flat and free from casting, and being quite level with the back surfaces, they are not unsightly. In the event of a small pair of doors being intro-

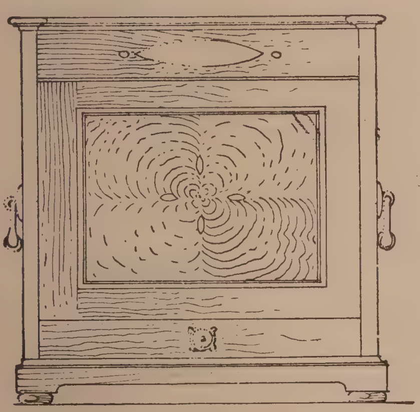


Fig. 5.

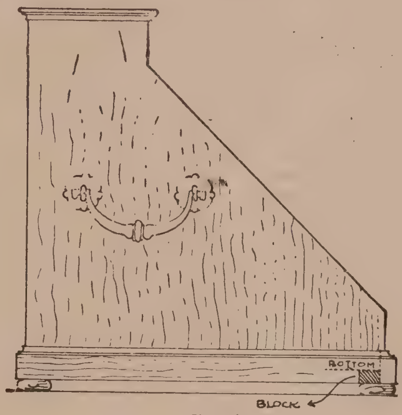


Fig. 6.

Figs. 5 and 6.—Front and Side Elevations of Mahogany Coal-box

duced, a different method of hinging is adopted, similar to ordinary door hinging. A pair of $1\frac{1}{4}$-in. or $1\frac{1}{2}$-in. brass butts are necessary for each door. The handles should be secured by sinking the nuts level with the insides of the box, turning them hard up with a forked-end screwdriver. If square nuts are fitted to the pins, $\frac{3}{4}$-in. holes $\frac{3}{16}$ in. deep should be sunk with a centre-bit, and the nuts tightened up finally with a hammer and punch.

COAL CABINET WITH FALLING FRONT

Fig. 7 shows a coal cabinet quite distinct in design from the orthodox coal-box. Front and back elevations and a sectional plan are shown by Figs. 9, 10 and 11 respectively.

The construction will be seen in the

Fig. 7.—Coal Cabinet with Falling Front

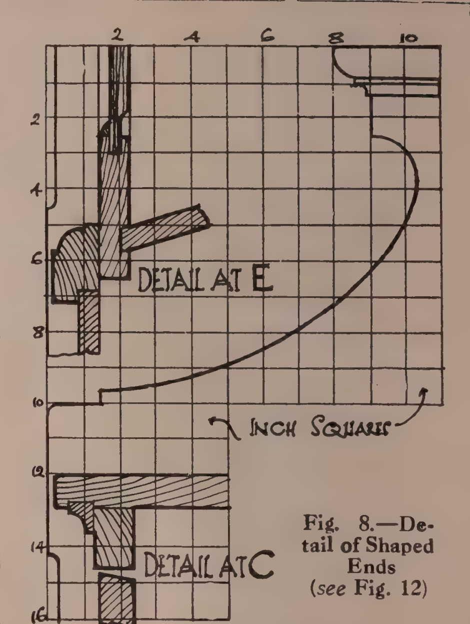


Fig. 8.—Detail of Shaped Ends (*see* Fig. 12)

various details. Each side is made up of two or more widths tongued together, shaped as in Figs. 8 and 12, and housed into a small top shelf as at A (Fig. 12), consisting of a moulded shelf proper, made out on its exposed edges by means of a moulded fillet 2 in. by $\frac{1}{2}$ in., as at B. Lower down, the sides are connected by (1) a rail C, $1\frac{1}{4}$ in. by $1\frac{3}{4}$ in.; (2) two back rails D, $1\frac{1}{2}$ in. by $2\frac{1}{2}$ in.; (3) a moulded front rail E, $1\frac{1}{4}$ in. by $2\frac{1}{4}$ in., with a skirting rebated to it on the underside, as at F in Figs. 9 and 12, and a main top G (Fig. 12), with a small moulding under its front edge. All these connecting portions are housed at least $\frac{1}{2}$ in. into the sides, and the carcase so formed is strengthened on the inside by means of angle-blocks, as shown in Figs. 12 and 13. Further strength is afforded by the filling in of the back, which at the top takes the form of a frame and panel or mirror, and at the bottom consists of light horizontal boarding (Fig. 10). Both frame and boarding should be well screwed into rebates in the back inner edges of the sides.

The outer box, into which the sheet-iron

coal-container fits loosely, should be grooved or tongued together in a simple substantial manner. It has a moulded panelled front, which can be emphasised by screwed in the corresponding positions on the outer sides of the box, the groove at M being continued as at N in Fig. 13, thus enabling the box to be inserted from the

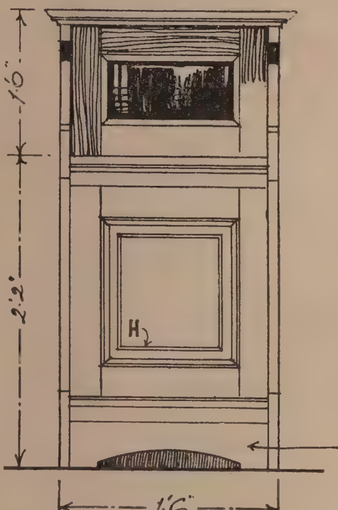


Fig. 9.—Front Elevation

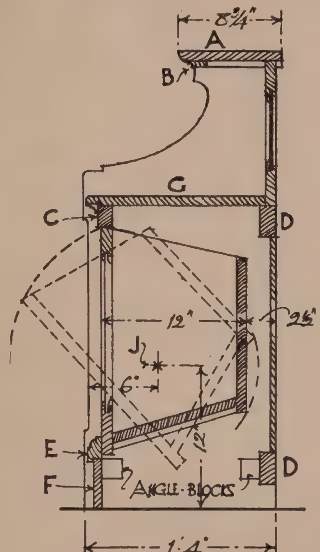


Fig. 12.—Vertical Section

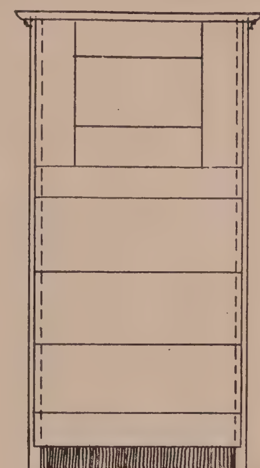


Fig. 10.—Back Elevation

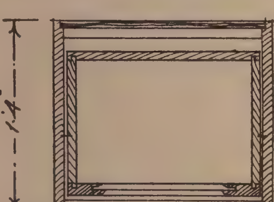


Fig. 11.—Sectional Plan

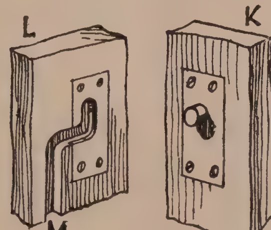


Fig. 14.—Socket and Pivot for Swinging Box

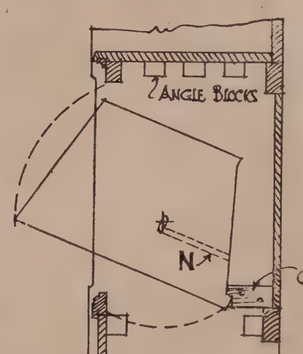


Fig. 13.—Section showing Groove for Pivot and stop for Box

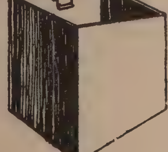


Fig. 15.—Metal Coal-containers

means of either a raised panel, or a small bead mitred round, as at H in Fig. 9. The point at J in Fig. 12 gives the exact position on the inner faces of the sides of the pivots or centres K (Fig. 14). The plate at L in the same figure is, of course, front of the cabinet, pushed home with the pivots sliding along the groove N, finally dropping into position as shown, when, on being released, it will by its own weight automatically close. A handle will be required near the top for opening, and

in order to prevent its swinging too far and depositing its contents on the floor, a couple of rebated stops, as at O (Fig. 13), should be fixed on the sides of the cabinet before the boarded back is finally fixed.

The metal coal-container (Fig. 15) should be galvanised if possible, and it will require a couple of drop-handles at the top for lifting away from the cabinet for refilling. A shovel-holder at the back of the container will also be useful.

Fig. 16.

Fig. 17.

Figs. 16 and 17.—Pedestal Coal Cabinet, shown Closed and Open

PEDESTAL COAL CABINET

The photographs reproduced by Figs. 16 and 17 show a coal cabinet of pedestal form. The construction and dimensions are shown in the two elevations, Figs. 18 and 19, and the part underneath plan (Fig. 20).

The two sides of the cabinet are of oak, 1 ft. 6¼ in. long by 1 ft. 1 in. wide by ¾ in. thick finished. The bottom is of deal, 1 ft. 3 in. long by 11½ in. wide by ¾ in. thick finished. The front lower rail A (Fig. 18) is of oak exactly the same length as the bottom by 3 in. wide and ¾ in. thick; and two more rails the same size, but of deal, are required. The bottom is dovetailed into the lower end of the oak sides, ¾ in. from the front edge and ½ in. from the back edge, these back edges being rebated ½ in. on the inner side, even with the bottom. The oak rail is also dovetailed into the sides, flush with the front edges, and screwed to the front edge of the bottom (*see* Fig. 21, where A is the rail, B the bottom, and C the oak side). The two deal rails are dovetailed into the top edges of the oak sides flush with the front edges and the rebates of the back edges; and pieces about 1 in. wide are fitted between screwed to the sides. Screw-holes are made in these and the rails for fixing the oak top of the cabinet (*see* Fig. 22, where D is the front deal rail, and E the piece screwed to the side). The oak top is 1 ft. 5 in. by 1 ft. 2 in. by ¾ in., and is fixed flush at the back, and to overhang ¾ in. at the front and sides. A moulding to the section shown by Fig. 23 is fixed under the overhanging top, and that shown by Fig. 24 is fixed round the bottom.

The feet are cut from a moulding to the section shown by Fig. 25. Fig. 26 shows the method of marking out, on a piece of moulding 2 ft. 6 in. long, the six pieces which form the front and sides of

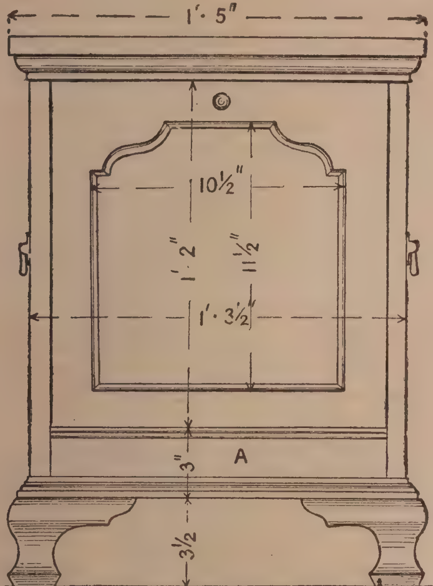


Fig. 18.

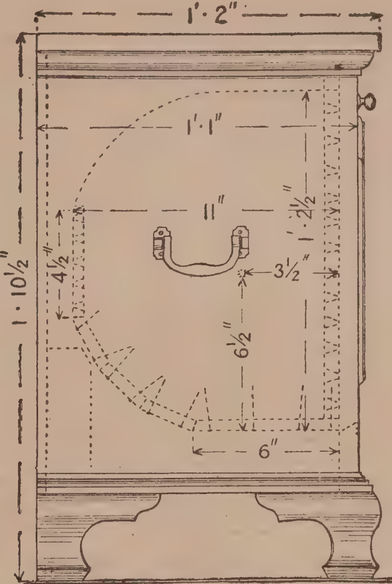


Fig. 19.

Figs. 18 and 19.—Front and Side Elevations of Pedestal Coal Cabinet

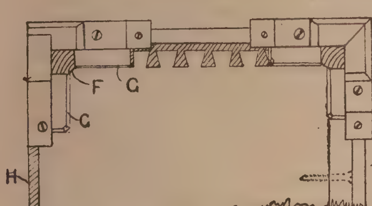


Fig. 20.—Part Underneath Plan

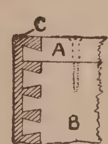


Fig. 21.—Part Underneath Plan of Bottom

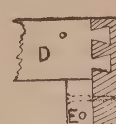


Fig. 22.—Plan of Front Corner under Top

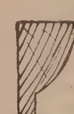


Fig. 23.—Section of Moulding under Top

Fig. 24.—Section of Moulding Round Bottom

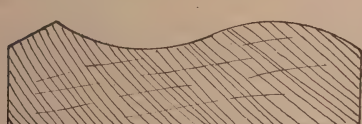


Fig. 25.—Section of Moulding for Feet

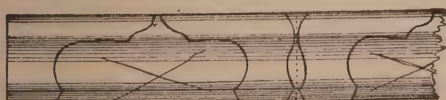


Fig. 26.—Half Length of Moulding Marked for Cutting Feet

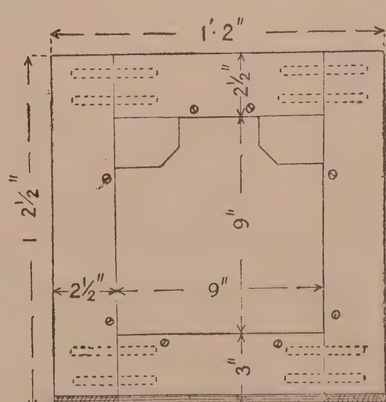


Fig. 27.—Detail of Construction of Front Frame

the feet. The dotted line shows the point at which they are mitred, which forms the curves at each side; the other lines which remove the waste are cut with a fret- or bow-saw. The back part of

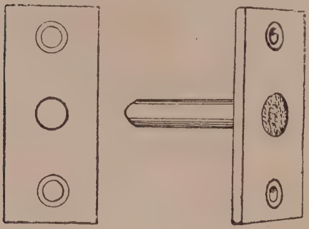


Fig. 28.—Pair of Movements for Swinging Inner Case

the back feet are of flat deal simply cut slant. Fig. 20 shows the construction of the feet. They are well fitted, and fixed in place with glue and screws. A corner block is glued in each foot, also two other blocks are glued behind the upper part of the feet pieces; F is the corner block of the back foot, and G the other blocks. A back of $\frac{1}{2}$-in. deal H (Fig. 20) is fitted and fixed in the rebate of the sides and to the back edge of the top rail and bottom, which completes the outer case of the cabinet, except the door frame and panel. Fig. 27 shows the dimensions and construction of the frame, which is of $\frac{3}{4}$-in. oak, the joints being dowelled and pieces glued in the top corners; the bottom edge is bevelled to fit against the lower front rail. The panel is of oak $\frac{5}{16}$ in. thick, the dimensions being given in Fig. 18.

The inside case is of whitewood, the dimensions and construction being shown in Fig. 19. The grain of the wood is horizontal all through in this case. The front measures 1 ft. $1\frac{1}{2}$ in. long by 1 ft. 2 in. wide by $\frac{5}{8}$ in. thick; the two sides 11 in. long by 1 ft. 2 in. wide by $\frac{1}{2}$ in. thick; the bottom 6 in. wide, back $4\frac{1}{2}$ in. wide, and three other pieces $2\frac{1}{2}$ in. wide, all the same length as the front piece by $\frac{1}{2}$ in. thick. The sides are dovetailed to the front and back pieces; the bottom is nailed on, and the three other pieces fitted round the lower curve of the sides are also nailed on. The front frame is fixed to the case with eight screws, as shown in Fig. 27, and the panel is secured with fine panel pins. In Fig. 19 is shown the dotted point for the swivel movement on which the inner case swings. Fig. 28 shows a pair of the movements, two pairs of which are required. They consist of two iron plates $2\frac{1}{4}$ in. by 1 in. by $\frac{1}{8}$ in., with a pin riveted in one, and countersunk screw-holes for fixing. The plate with the hole is fixed inside the outer case, and the one with the pin inside the inner case. It is important that these are accurate, or the cabinet will not keep closed or open as required. Therefore the

Fig. 29.—Pedestal Coal Cabinet—Back View

case should first be swung on nails with the iron lining in, and tried.

A small brass knob is put on the front top rail, and two wood blocks are fixed inside the lower back corners of the outer case to keep the inner one from opening too far, as shown in Fig. 19. A pair of handles are put on the sides, and a set of dome casters on the feet.

Fig. 29 is a photographic reproduction of the back view of the cabinet.